Monnaies mobiles sociales : viabilité et efficacité économiques

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Introduction générale

Les consommateurs ont aujourd'hui la possibilité et le choix d'utiliser des moyens de paiements diversifiés, allant des espèces à des moyens sophistiqués offerts par les technologies numériques. Cette diversification est le résultat combiné d'une tendance croissante à la dématérialisation et de l'émergence d'initiatives privées dans l'émission de ces nouveaux moyens de paiement, source de concurrence dans le secteur de l'intermédiation monétaire. Cette diversité des moyens de paiement n'est pas toujours aussi importante selon les différentes régions du monde. Elle s'adapte à la culture, aux usages et à la législation en vigueur. Cette diversification est aussi caractérisée par l'émergence de nouveaux outils de paiement créés dans le but de promouvoir des objectifs économiques spécifiques, tels que le développement économique local, le retour à l'emploi, l'inclusion sociale et l'inclusion financière. Ils proposent alors une valeur sociétale aux utilisateurs au-delà de la simple délivrance d'un service de paiement. La forme de ces instruments, leur mise en place, ainsi que les acteurs associés à ces projets, diffèrent selon les objectifs promus et la localité choisie, offrant ainsi un panel varié d'usages aux consommateurs. Cette thèse a été financée dans le cadre du projet FIRST (*"Financial Inclusion based on upon Rural mobiquitous Services Technological platform"*). FIRST est une solution permettant de donner l'accès à des services financiers par le biais du téléphone mobile à des personnes non bancarisées vivant en milieu rural en Inde. Ce projet mobilise divers acteurs, industriels et universitaires: Tata Consultancy Services (TCS), GEMALTO, l'Indian Institute of Science, Bangalore (IISc), et l'Université Nice Sophia Antipolis (UNS). Il est né de la volonté de prendre part à l'élaboration de ces nouveaux moyens de paiement sociaux en coordonnant les expériences d'acteurs complémentaires. Plus qu'un terrain d'analyse, FIRST a été le point de départ de cette thèse, tant par la

rencontre de points de vue qu'il a générée, que par les enjeux qu'il a soulevés. Cette thèse s'est donc concentrée sur ces monnaies dites "sociales" (Blanc, 2006) circulant par le biais du téléphone mobile de leurs utilisateurs et majoritairement impulsées par des initiatives privées. Elle propose ainsi une réflexion autour des enjeux concernant les conditions d'émergence, la viabilité et l'efficacité de telles initiatives. Elle s'articule autour de trois chapitres distincts selon les différentes formes de monnaies mobiles sociales et les organisations à l'initiative de leur déploiement. Dans un premier temps, il convient de revenir sur les tendances technologiques actuelles, sociétales, et réglementaires qui ont permis la naissance et la diffusion de ces nouveaux moyens de paiement.

Evolution de l'utilisation des moyens de paiements, traditionnels et innovants

De la prépondérance du cash vers une dématérialisation des échanges

Les espèces conservent une place prépondérante dans nos économies. Une étude comparative menée de 2009 à 2012 en Australie, en Autriche, au Canada, en France, en Allemagne, aux Pays Bas et aux Etats-Unis, révèle que dans ces pays les espèces sont encore utilisées pour 46 à 82% des transactions réalisées par les consommateurs au cours d'une année (Bagnall et al, 2014). Cependant, les espèces resteraient, dans les économies développées, un outil privilégié pour le règlement des transactions de petits montants (Jonker et al., 2012; Bouhdaoui et Bounie, 2012; Deutsche Bundesbank, 2013). Dans 40% des pays du monde, les impôts sont encore réglés en espèces et dans un peu plus de 10% de ces pays les salaires du service public, les retraites et les revenus de transfert sont payés en liquide. Ce dernier taux est beaucoup plus élevé dans les pays à faible revenu (30%). En effet, certains pays, notamment émergents et en développement, réalisent encore majoritairement leurs transactions en espèces. C'est le cas de l'Inde, de l'Indonésie, de la Chine ou de la Malaysie, où plus de 90%

des transactions effectuées sont réglées en liquide (McKinsey, 2012). Cela s'explique notamment par une très faible bancarisation des habitants de ces pays, due à un manque de confiance dans les institutions, un manque d'infrastructures bancaires, un manque d'information (WEF, 2011), et une préférence historique pour les espèces - les salaires sont par exemple versés en espèces (Banque Mondiale, 2014). La Banque Mondiale (2012a) révèle que seulement 23% de la population dans les pays à faible revenu possède un compte bancaire (cette proportion s'élève à 43% dans les pays à moyen revenu). Cependant, malgré cet ancrage encore persistant des transactions effectuées en espèces, les transactions réalisées à l'aide de moyens de paiements électroniques sont en hausse dans ces pays (McKinsey, 2012). Cette évolution dans l'utilisation des moyens de paiement électroniques semble attester d'un recul dans l'usage des espèces. Selon des études récentes menées en Europe, le nombre et le volume des transactions autres qu'en espèces sont en constante augmentation (EBF, 2012, 2013). Ce résultat est renforcé par la constation de la diminution du nombre de retraits de billets aux distributeurs automatiques dans les pays européens (EBF, 2013). Nos économies semblent transiter vers des économies sans espèces, favorisant les outils de paiements électroniques au papier.

L'usage des moyens de paiements électroniques traditionnels croît toujours...

Une enquête de la Banque Mondiale (2010) révèle que dans les pays développés plus de 100 transactions par an et par personne sont réalisées sans espèces. En moyenne, les pays de la zone euro en comptabilisent 169 par an, les autres membres de l'Union Européenne 117 et les "autres pays développés", tels que l'Australie, le Japon, Israël, la Nouvelle Zélande, et les Etats Unis, en réalisent 190 par an. Parmi les paiements effectués sans espèces dans ces pays, 99% sont encore initiés via les outils traditionnels de paiements - prélèvements automatiques (15%), virements (17,5%), cartes de crédit et de débit (53%), chèques (13,5%) (CPSS, 2012). Si les cartes de paiement restent le moyen de paiement préféré des pays développés, et que leur usage aug-

mente (en volume et en valeur), l'utilisation du chèque diminue, tant en volume qu'en valeur (CPSS, 2012; EBF, 2013).

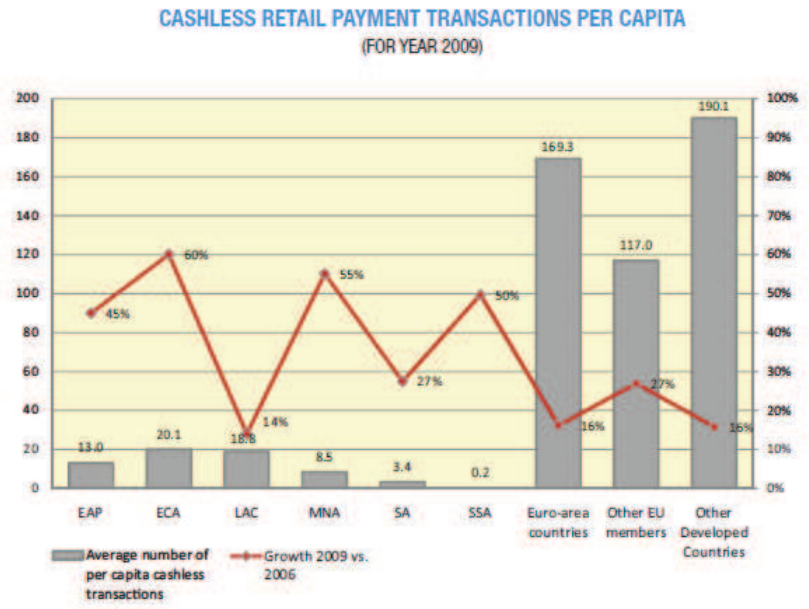

Figure 1: Nombre de transactions autres qu'en espèces dans les différentes régions du monde, 2009 Payments Systems Worldwide, a Snapshot; Banque Mondiale (2010)

Cette tendance n'est pas observable partout dans le monde. Elle se manifeste différemment selon la richesse des pays observés. Effectivement, si les pays développés sondés par la Banque Mondiale en 2010 réalisaient plus de 100 transactions sans espèces par an, les pays émergents et en développement n'en réalisaient que 20 ou moins. Le profond ancrage de ces pays dans l'utilisation des expèces explique leur faible utilisation des moyens de paiements électroniques. De plus, le chèque reste le moyen majoritairement utilisé dans les transactions sans espèces (à 60%) dans les pays à faible revenu.

... mais moins rapidement que l'usage des systèmes de paiements électroniques innovants

Si les moyens de paiements électroniques traditionnels restent privilégiés dans les échanges sans liquide, une enquête réalisée par la Banque Mondiale (2012b) dans

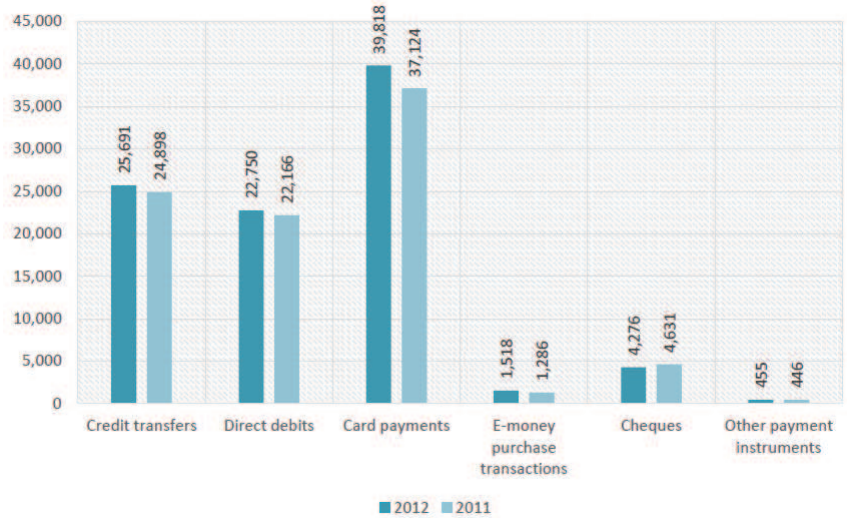

Figure 2: Nombre de transactions autres qu'en espèces par moyen de paiement dans l'Union Européenne à 27, 2012 (million) European Banking Sector Facts and Figures 2013; European Banking Federation (2013)

101 pays révèle que dans 69% des pays sondés l'utilisation des moyens de paiements innovants augmente, englobant les systèmes de paiements électroniques tels que les monnaies électroniques essentiellement, circulant via divers instruments - cartes électroniques, ordinateurs, téléphones mobiles. 55% de ces mêmes pays affirment que l'utilisation de ces nouveaux moyens de paiement augmente plus vite que celle des moyens de paiement traditionnels.

La Banque Centrale Européenne confirme cette tendance au niveau européen en constatant que la hausse la plus importante dans l'utilisation des moyens de paiement par les européens est celle de la monnaie électronique (+18% en volume et +30% en valeur de 2011 à 2012), dont l'usage croît plus rapidement que celui des cartes de paiement (EBF, 2013). Cependant, l'usage de la monnaie électronique reste très inégal selon les pays, même développés. En effet, à Singapour 85,5% des échanges réalisés sans espèces sont réglés en monnaie électronique, alors qu'ils ne représentent que 0,2% en Allemagne et 1,1% en Suisse (CPSS, 2012).

Une tendance à la dématérialisation des moyens de paiements qui fait émarger un nouveau panorama d'outils

Les réseaux informatiques ouverts, tels qu'Internet, ont favorisé les échanges et les transactions dématérialisés, faisant émerger de nouveaux systèmes de paiement, et de nouvelles façons d'échanger. Les systèmes de paiement électroniques (SPE) sont nés de ces progrès technologiques et peuvent se définir comme "l'ensemble des moyens et des modes de transmission sécurisés des dettes financières sur les réseaux ouverts" (Bounie, et al., 2000 ; Bounie, 2001). Aujourd'hui, les comptes bancaires des utilisateurs leur sont désormais accessibles partout et à n'importe quel moment, via la technologie Internet, leur offrant la possibilité de payer, transférer et recevoir de l'argent électroniquement. L'émergence des services de banque en ligne offrent de nouvelles possibilités aux consommateurs de ces services. Désormais, le face-à-face entre les échangeurs n'est plus nécessaire, les utilisateurs pouvant échanger de l'argent de façon sécurisée avec des outils de paiement faciles d'utilisation (Banque Mondiale, 2012b). Ainsi, certains moyens de paiement comme le transfert de fonds par virement ne sont plus nécessairement initiés depuis une agence bancaire.

Ces nouvelles possibilités technologiques ont également fait émerger des systèmes de paiements électroniques, complémentaires aux systèmes existants. C'est le cas de la monnaie électronique, dont la définition ne fait pas consensus dans la littérature. Il s'agit d'une valeur monétaire stockée (Banque Centrale Européenne, 1998; BIS, 1998; Parlement européen, 2000; Bounie, 2001; CPSS, 2004; Parlement européen, 2009) ou d'un mécanisme de paiement pré-payé (BIS, 1998) enregistré sur des dispositifs électroniques, tels que des cartes électroniques ou des disques durs d'ordinateurs (Banque Centrale Européenne, 1998; BIS, 1998; CPSS, 2004), des serveurs ou en réseau (BIS, 1998; CPSS, 2004; Parlement européen, 2009). La monnaie électronique représente une créance sur l'émetteur (Parlement européen, 2000; Bounie, 2001), est "émise contre la remise de fonds d'un montant dont la valeur n'est pas inférieure

à la valeur monétaire émise" (Directive 2000/46/CE du Parlement Européen et du Conseil, 18 septembre 2000; CPSS, 2004) et permet à son utilisateur d'effectuer des paiements à destination de tiers autres que l'émetteur de cette monnaie (Parlement européen, 2000; CPSS, 2004; Parlement européen, 2009). Les banques ne sont pas les seuls acteurs pouvant émettre de la monnaie électronique, celle-ci n'étant pas forcément rattachée au compte bancaire de leurs utilisateurs (BIS, 1998; Banque Centrale Européenne, 1998).

De la déconnexion du compte bancaire...

On peut distinguer deux générations de monnaies électroniques (Aglietta et Scialom, 2002; Brack, 2003). La monnaie électronique de première génération s'apparente aux paiement électroniques traditionnels évoqués précédemment. En effet, il s'agit de monnaie électronique émise par les banques, circulant dans des réseaux fermés et circulant via des cartes bancaires, des virements et des prélèvements automatiques. La monnaie électronique de seconde génération se distingue alors de celle de la première génération par sa circulation sur des réseaux ouverts, tels qu'Internet. Son émission n'est plus réservée aux établissements bancaires et l'ouverture du secteur financier à la concurrence la caractérise. La monnaie électronique de seconde génération au sens d'Aglietta et Scialom (2002) englobe donc les opérations bancaires réalisées sur les réseaux ouverts (banque électronique) et les monnaies dites "privées" émises par des tiers de confiance, après un dépôt préalable de valeurs par l'utilisateur, créditées sur un dispositif ou un compte électronique.

La définition de la monnaie électronique peut cependant être affinée. En effet, Bounie (2001) précise cette définition de la monnaie électronique abordée précédemment et scinde ce moyen de paiement en deux catégories distinctes : les systèmes de paiements électroniques (SPE) articulés autour d'un compte non bancaire et la monnaie électronique. Les paiements électroniques peuvent être initiés depuis des comptes non bancaires (Bounie, et al., 2000; Bounie, 2001), tel que Paypal, et la transaction initiée est alors garantie par un intermédiaire non bancaire, qui prend le

rôle d'intermédiaire de confiance des échanges. On parle alors de SPE articulés autour d'un compte non bancaire. D'autre part, les SPE peuvent aussi n'être rattachés à aucun compte, bancaire ou non bancaire. On parle alors de monnaie électronique. Pour utiliser la monnaie électronique, le consommateur crédite un porte-monnaie électronique, depuis son compte ou en liquide, dans lequel sera stockée sa monnaie. Il s'agit donc d'instruments de paiement pré-payés. Ainsi, le consommateur peut initier un échange depuis une carte électronique ou depuis son téléphone mobile, même pour de très petits montants (Parlement européen, 2009). La monnaie électronique se substitue au liquide, les dispositifs électroniques de stockage jouant alors le rôle de billets et de pièces.

... à la totale déconnexion de la matérialité?

Enfin, le panorama des systèmes de paiements électroniques a vu émerger les monnaies virtuelles, sous-catégorie des monnaies électroniques (Banque Centrale Européenne, 2012). Selon la BCE, la monnaie virtuelle est "une forme de monnaie électronique non réglementée, qui est émise et contrôlée par ses développeurs, et utilisée et acceptée parmi les utilisateurs d'une communauté virtuelle spécifique." La notion de communautés virtuelles fait appel à deux concepts, à la fois à un lieu au sein du cyberespace, et à la fois à un regroupement d'individus interagissant autour des mêmes intérêts et/ou des mêmes buts. Il existe plusieurs formes de monnaie virtuelle selon la BCE (2012), les systèmes fermés, les systèmes à flux unidirectionnels, et les systèmes à flux bidirectionnels. Les monnaies virtuelles circulant dans un système fermé sont souvent utilisées dans les jeux en ligne où les joueurs peuvent acquérir de la monnaie via leurs performances dans le jeu et acheter ainsi des biens virtuels. Les systèmes de monnaie virtuelle à flux unidirectionnels permettent aux utilisateurs d'acheter cette monnaie via une devise officielle, mais elle ne peut être revendue, et les utilisateurs ne peuvent acheter que des biens virtuels. Enfin, le système de monnaie virtuelle à flux bidirectionnels permet aux utilisateurs d'acheter et de vendre de la monnaie virtuelle via des devises officielles et de réaliser des transactions dans l'économie réelle.

Catégoriser les nouveaux systèmes de paiement, une entreprise délicate

Les nouveaux systèmes de paiement peuvent prendre diverses formes. Même l'édition de définitions claires et précises de ces nouveaux moyens de paiement ne permet pas de classer de façon catégorique ces nouveaux outils. Effectivement, les définitions diffèrent selon les auteurs, comme c'est le cas pour la monnaie électronique, et certains nouveaux moyens de paiement développent des caractéristiques empruntées à plusieurs définitions de systèmes de paiement. Mêmes certains nouveaux moyens de paiement, tels que le Bitcoin, cités comme illustration des définitions proposées ne peuvent être catégorisés de façon incontestable.

En effet, l'exemple très connu du Bitcoin, moyen de paiement international de renom, a été choisi par la BCE (2012) pour illuster le concept de monnaie virtuelle. Les utilisateurs peuvent acquérir cette monnaie virtuelle en convertissant de la monnaie officielle ou en la générant eux-mêmes en mettant à disposition du système la force de calcul de leurs odinateurs ou serveurs. La monnaie achetée ou générée est alors stockée dans un porte-monnaie électronique et les consommateurs peuvent l'utiliser pour réaliser des achats sur Internet ou dans des commerces acceptant cette monnaie. Cette monnaie, décentralisée et non réglementée, n'est assurée par aucun tiers de confiance qui prémunirait les utilisateurs contre les hacks ou la perte du porte-monnaie électronique. Si le Bitcoin remplit de nombreux critères caractérisant la monnaie virtuelle cités par la BCE (2012) - monnaie inventée, électronique, non garantie - le Bitcoin ne s'établit plus seulement au sein d'une communauté virtuelle. En effet, si on peut parler de "Bitcoiners" pour caractériser la communauté d'utilisateurs s'échangeant cette monnaie, celle-ci est de moins en moins virtuelle, ses utilisateurs n'interagissant plus uniquement sur le cyberespace. Le Bitcoin s'échange de plus en plus pour l'achat et la vente de biens et de services réels (et non plus uniquement virtuels). Si l'acceptation du Bitcoin reste encore

majoritairement cantonnée à certains commerces de proximité (cafés, restaurations rapides), celle-ci est de moins en moins restreinte. A titre d'exemple, deux universités (Nicosie à Chypre et Cumbria en Angleterre) ont déclaré accepter le réglement des frais de scolarité en Bitcoin. De plus, si cette monnaie reste non garantie, elle a attiré l'attention de certains Etats qui ont réglementé son utilisation. En effet, le Bitcoin devient dans certains pays une monnaie reconnue et les plus-values réalisées lors de la vente de Bitcoins peuvent être imposées. C'est le cas de l'Allemagne qui a reconnu le statut de "monnaie privée" au Bitcoin, permettant à l'administration fiscale de taxer les bénéfices réalisés par ses utilisateurs.

On peut également citer à titre d'exemple le cas des monnaies complémentaires, circulant partout dans le monde, mais dont l'échelle d'acceptation est limitée à une ville ou un quartier. En effet, leurs caractéristiques rendent leur classification délicate. Ces monnaies sont, pour certaines, dématérialisées, comme le Bristol Pound (Angleterre) ou l'Occito et la SoNantes (France). Elles s'acquièrent en convertissant de la monnaie officielle en unités de monnaies complémentaires qui sont alors stockées dans un porte-monnaie électronique, garanti par un organisme bancaire et accessible via son téléphone mobile, son ordinateur ou une carte électronique. Elles peuvent ensuite être dépensées dans les commerces locaux qui les acceptent. Si ces dernières caractéristiques des monnaies complémentaires les classeraient dans la catégorie des monnaies électroniques, il n'en reste pas moins que ces monnaies sont introduites par des personnes ou des organisations autres que les pouvoirs publics, c'est-à-dire qu'elles ne sont pas des devises officielles, critère qui les apparenterait à des monnaies virtuelles. Cependant, il semblerait que cette introduction de nouvelles monnaies soit l'unique spécificité les rapprochant des monnaies virtuelles. En effet, ces monnaies sont réglementées, comme c'est le cas en France (Loi 2014-856 du 31 juillet 2014 relative à l'économie sociale et solidaire) ou en Belgique (Loi du 21 décembre 2009 relative au statut des établissements de paiement, à l'accès à l'activité de prestataire de services de paiement et à l'accès aux systèmes de paiement). De plus, elles sont pour la plupart adossées aux monnaies officielles, garanties, souvent par des établissements bancaires, et elles ne circulent pas au sein d'une communauté

virtuelle.

Le cas de la monnaie mobile, lui aussi fait débat. Plus souvent déployé dans les pays émergents et en développement, il s'agit d'un système de paiement électronique prépayé permettant à des utilisateurs non bancarisés de déposer leurs espèces chez des agents accrédités et de bénéficier de l'utilisation de services financiers via leur téléphone mobile (paiements, transferts d'argent, etc.). Dans la majorité des cas, ces monnaies mobiles sont émises et garanties par des tiers de confiance non bancaires, tels que des fournisseurs de paiements électroniques ou des opérateurs de téléphonie mobile, qui s'occupent de gérer les comptes des utilisateurs et de prendre en charge la compensation des paiements. Les fonds des utilisateurs sont stockés sur la carte SIM fournie par l'opérateur de téléphonie mobile émetteur de la monnaie mobile ou partenaire du système et sert alors de porte-monnaie électronique à l'utilisateur. Selon la définition de la monnaie électronique du Parlement européen (2009), cette notion décrit les valeurs stockées sur un dispositif électronique ou un serveur à distance et gérées par les utilisateurs via un compte specifique de monnaie électronique. Selon cette définition, la monnaie mobile pourrait alors être classée en tant que monnaie électronique. Cependant, les modèles d'affaires de la monnaie mobile sont nombreux, parfois contraints par certaines réglementations éditées dans les pays implémentés. La monnaie mobile peut donc être proposée par un organisme bancaire ou non-bancaire, impactant alors directement sa classification. En effet, la monnaie mobile offerte par des banques entraîne l'ouverture d'un compte bancaire pour l'utilisateur (c'est le cas pour certains modèles collaboratifs). Dans ce cas de figure, la monnaie mobile ne rentre pas dans la définition de la monnaie électronique au sens de Bounie (2001). Le compte de monnaie mobile est directement rattaché au compte bancaire de l'utilisateur.

Certains autres moyens de paiement électroniques sont en revanche plus facilement catégorisables. C'est le cas par exemple de Moneo qui remplit toutes les caractéristiques de la monnaie électronique, au sens à la fois des institutions (BCE, 1998; BIS, 1998; Parlement Européen, 2000; CPSS, 2004), de Aglietta et Scialom

(2002) et de Bounie (2001). En France, la monnaie électronique Moneo est créditée sur une carte électronique, par un transfert de fonds via la carte bancaire de ses utilisateurs, et peut être dépensée dans les commerces qui l'acceptent. La carte électronique, sur laquelle sont stockés les fonds, est alors similaire à un billet de banque ou à une pièce de monnaie. Si l'utilisateur perd cette carte, il perd également la valeur stockée sur cette carte. Cette monnaie électronique lancée en France en 1999 est aujourd'hui en train de disparaître faute d'utilisateurs.

L'émergence de nouveaux acteurs

L'offre de nouveaux moyens de paiement n'est plus l'apanage des banques

L'émergence des systèmes de paiement électroniques et de la monnaie électronique fait apparaître de nouveaux acteurs dans le paysage bancaire et financier. En effet, les banques ne sont plus les seuls fournisseurs de services financiers, des acteurs privés non bancaires ayant proposé leurs nouvelles solutions de paiement et monnaies électroniques aux utilisateurs. L'enquête réalisée par la Banque Mondiale (2012b) fait apparaître cette diversité des acteurs pouvant offrir des services de paiements innovants. Si ce marché est encore majoritairement servi par les banques (à plus de 90%), il s'est ouvert à de nouveaux acteurs non bancaires, tels que des bureaux de poste (à plus de 40%), des sociétés non financières (à 30%), ou encore d'autres acteurs privés (15%) tels que des opérateurs de téléphonie mobile. De plus, dans les pays connaissant de faibles taux de bancarisation, l'opportunité d'offrir des services financiers à une population faiblement bancarisée a été saisie par des acteurs privés, essentiellement des opérateurs de téléphonie mobile (Pénicaud C. and Katakam A., 2013). Ces nouveaux acteurs peuvent alors choisir le type de relations partenariales qu'ils souhaitent nouer avec les banques, selon divers modèles d'affaires associés (Chaix, 2013; Chaix et Torre, 2015) et la réglementation en vigueur dans ces pays.

Une ouverture réglementée du secteur financier

Cette ouverture du secteur financier à la concurrence fait émerger la nécessité d'un cadre réglementaire adapté, promulgué par les banques centrales des pays en question, offrant la possibilité à des acteurs non bancaires d'émettre leur monnaie électronique (Chaix, 2013). Il a alors été nécessaire d'établir de nouvelles définitions, de définir des frontières précises pour ces nouvelles activités et de détecter les nouveaux acteurs sur le marché. C'est le cas notamment de la Banque Centrale Européenne qui, pendant plusieurs années (Rapport sur la monnaie électronique (1998), Directive européenne 2000/46/CE, Directive européenne 2007/64/CE, Directive européenne 2009/110/CE), a continuellement cherché à améliorer le cadre réglementaire de ces nouvelles activités dans un souci de bien-être des consommateurs et de concurrence loyale des nouveaux acteurs. En effet, elle a défini successivement deux statuts permettant à des acteurs non bancaires de participer au système financier, les établissements de monnaie électronique (2000, 2009) et les établissements de paiement (2007). Ces deux statuts offrent la possibilité à des acteurs non bancaires de proposer des services de paiement électroniques (établissement de paiement) et d'émettre de la monnaie électronique (établissement de monnaie électronique), nécessitant un agrément délivré par les autorités compétentes des pays membres. Outre le champs d'application de ces deux statuts, les directives européennes relatives édictent des règles prudentielles en matière de capital et de niveau de fonds propres minimum, de protection des fonds des utilisateurs et de conditions d'octroi et de retrait de l'agrément. Par exemple, pour la protection des fonds des consommateurs, les établissements de paiement et de monnaie électronique sont tenus de placer les fonds des utilisateurs dans un ou plusieurs comptes à vue auprès des établissements de crédit agréés et/ou de bénéficier d'un engagement de couverture de fonds écrit d'un établissement de crédit ou d'une entreprise d'assurance habilitée. Pour tenir compte des avancées financières, la première directive européenne de 2000 réglementant l'activité d'émission de monnaie électronique a été assouplie en 2009. Depuis, les établissements de monnaie électronique peuvent également exercer des activités de paiement et bénéficier des avantages liés au statut d'établissement de paiement (possibilité de mener conjointement une activité commerciale et une

activité de services de paiement, possibilité d'octroyer des crédits dans le cadre du service de paiement). Les établissements de paiement et de monnaie électronique sont également soumis à des obligations de contrôle dans le cadre de la lutte contre le blanchiment des capitaux et le financement du terrorisme. Ces établissements sont tenus de vérifier l'identité de leurs clients. Les établissements de monnaie électronique sont affranchis des obligations de vigilance jusqu'à 250 euros pour les instruments non rechargeables et 2 500 euros pour les instruments rechargeables.

Une réglementation qui peine à s'établir dans certains pays

L'Union Européenne n'est pas la seule à avoir autorisé les acteurs non bancaires à rentrer sur le marché. En effet, de nombreux pays ont édicté des cadres réglementaires cléments à cette nouvelles concurrence. C'est le cas de l'Afghanistan, de la Namibie, de la Bolivie, du Burundi,de la République Démocratique du Congo, du Kenya, de la République de Madagascar, de Malawi, de la Malaysie, du Maroc, du Paraguay, des Philippines, du Rwanda, de la Somalie, du Sri Lanka, de la Tanzanie, des Tonga, de l'Ouganda, de la Zambie, du Zimbabwe (Di Castri, 2013), des pays membres de la Banque Centrale des Etats de l'Afrique de l'Ouest (BCEAO), entre autres. Si les exemples de pays ayant accepté la possibilité pour des tiers de confiance non bancaires d'émettre de la monnaie électronique sont nombreux, certains autres n'ont toujours pas ouvert leur secteur financier à d'autres acteurs privés que les banques. C'est le cas notamment du Népal, où seules les banques commerciales et les banques de développement ont l'autorisation d'émettre de la monnaie électronique (Unified Directive 2067, Nepal Rastra Bank, 2008). C'est aussi le cas du Bangladesh où l'émission de monnaie électronique doit être obligatoirement impulsée par les banques (Banque Centrale du Bangladesh, 2012). Au Nigeria, l'émission de monnaie électronique n'est pas ouverte à tous les acteurs non bancaires, les opérateurs de téléphonie mobile ayant été évincé de la concurrence, ne pouvant offrir qu'un support technique aux fournisseurs de paiements électroniques (Banque Centrale du Nigéria, 2014). Cependant, ces réglementations ne sont pas immuables et peuvent être révisées pour tenir compte des possibilités offertes par la technologie comme

il a été le cas au Sri Lanka où la Banque Centrale a finalement autorisé en 2011 l'émission de monnaie électronique par des acteurs non bancaires (Banque Centrale du Sri Lanka, 2011).

Sécuriser les échanges sur les réseaux ouverts

L'émergence de systèmes de paiement électroniques permettant aux utilisateurs de réaliser des transactions sur les réseaux ouverts a fait naître conjointement la nécessité de sécuriser ces échanges. Là encore, les acteurs bancaires et non bancaires à l'initiative de ces nouveaux systèmes sont tenus d'assurer la protection des consommateurs. La BCE (2013), sans pour autant établir de directives légales, propose tout de même une liste de recommandations pour la sécurité des paiements effectués sur les réseaux ouverts. Ces recommandations concernent particulièrement les paiements par carte sur Internet, les virements sur Internet, les mandats électroniques et les transferts de monnaie électronique. Ce guide instaure des préconisations que tout fournisseur de paiement électronique devrait suivre pour l'implémentation et le développement de leur système. Tout d'abord, les fournisseurs de services de paiement doivent assurer la protection de l'initiation des paiements sur Internet et sécuriser l'accès aux données sensibles concernant les paiements via une procédure d'authentification de l'utilisateur requérant au moins deux des éléments suivants: un système sécuritaire basé sur "la connaissance" de l'utilisateur (mot de passe, code, numéro d'identification personnel), un système basé sur la "propriété" de l'utilisateur (téléphone mobile, carte électronique), et un système basé sur les caractéristiques de l'utilisateur (caractéristiques biométriques). Les consommateurs doivent être informés en détail sur les procédures de sécurité mises en place par le fournisseur et sur les étapes de la transaction initiée et devraient avoir la possibilité de signer un contrat spécialisé pour le paiement sur Internet plutôt que de signer les actuels termes et conditions inclus dans le contrat de service général. Enfin, les systèmes de sécurisation des paiements électroniques mis en place par un fournisseur doivent être régulièrement audités par des experts internes et externes afin de veiller à leur efficacité.

Complémentarité des nouveaux systèmes de paiement

Les nouveaux moyens de paiements électroniques offrent de nouvelles possibilités d'usage et de nouvelles perspectives à leurs utilisateurs. En effet, les moyens de paiements existants, traditionnels et innovants, leur permettent de réaliser des transactions via de nouveaux canaux à l'aide de nouveaux outils. La pérennité de tous les moyens de paiement, circulant côte-à-côte, révélerait leur complémentarité plutôt que leur substituabilité.

Complémentarité des usages

De nouveaux usages sont désormais ouverts aux utilisateurs grâce au développement des nouveaux moyens de paiements électroniques et chacun de ces outils a sa spécificité. En effet, selon le montant de la transaction ou le canal d'échange utilisé, un ou plusieurs moyens de paiements seront privilégiés. Une étude du BIS (2012) révèle que chaque instrument est privilégié dans différents cas de figure. Le liquide par exemple sera plutôt utilisé pour les paiements de proximité et les paiements entre personnes. Les transactions sur Internet se régleront plutôt via des virements ou par carte de crédit. Cette complémentarité des usages est également confirmée dans une étude réalisée en France par Bounie et François (2006) qui arrivent aux conclusions que selon le montant de la transaction, le type de magasin ou le produit acheté, les outils de paiement utilisés ne seront pas les mêmes. Effectivement, les espèces restent privilégiées pour les transactions de petit montant (90% des transactions de moins de 5 euros sont réalisées en liquide) et pour des paiements réalisés chez de petits commerçants (80% des paiements effectués dans des petits magasins sont réglés en espèces). La carte de crédit (la carte de débit étant très peu utilisée en France) est privilégiée pour les transactions de montant moyen jusqu'à 150 euros, le chèque est ensuite l'outil favorisé. Elle est également plus usuellement utilisée pour les paiements dans de grands magasins ou des supermarchés (52% des transactions

effectuées dans ces magasins sont payées par carte de crédit).

Ces nouveaux moyens de paiement offrent de nouvelles opportunités de paiements et de nouveaux usages à leurs utilisateurs, rendues possible grâce aux avantages qu'ils procurent aux consommateurs. Selon une étude IFOP (2012) réalisée sur l'usage des moyens de paiement électroniques (de première et deuxième génération), les interviewés français révèlent que la rapidité, la simplicité et la traçabilité de ces moyens de paiement sont les principaux avantages qu'ils procurent par rapport aux transactions effectuées en espèces.

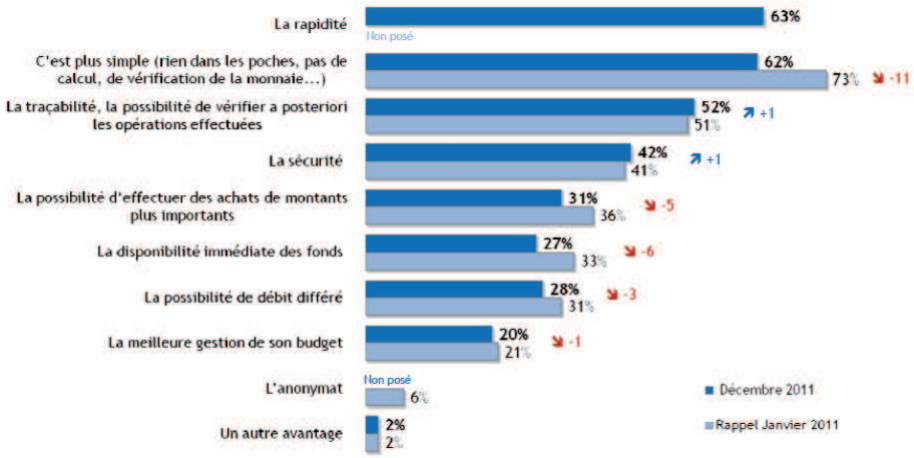

Figure 3: Avantages des moyens de paiement électroniques par rapport à l'argent liquide Baromètre du paiement électronique Vague 2; IFOP (2012)

A ces avantages relevés par les français s'ajoutent des avantages identifiés dans la littérature sur le coût d'utilisation des espèces et les modèles de choix d'utilisation d'un moyen de paiement. Baumol (1952) met en exergue le coût de détention des espèces. Les utilisateurs, en retirant des espèces de leur compte, supportent à la fois un coût de conversion de l'épargne en liquide et un coût d'opportunité inhérent au renoncement à la rémunération de l'épargne lors du retrait de liquidités du compte d'épargne. Whitesell (1989, 1992) évoque également ce coût d'opportunité supporté par le consommateur qui détient du liquide, et précise que seules les espèces sont utilisées pour les transactions de petit montant en raison du coût fixe des moyens de paiement liés au compte bancaire de l'utilisateur (frais bancaires). Ces

modèles qui analysent la recherche du moyen optimal de paiement pour l'utilisateur (Baumol, 1952; Whitesell, 1989, 1992; Santomero et Seater, 1996) confirment la complémentarité des différents moyens de paiement selon les coûts de transaction et de détention de chacun.

Cependant, cette complémentarité dans les usages des nouveaux moyens de paiement est contestée. En effet, pour être totalement complémentaires, les moyens de paiement doivent aussi être généralement acceptés, ce qui n'est pas observé dans la réalité. Berentsen (1998) montre que l'adoption d'un moyen de paiement dépendra des actions supposées des autres agents. Les agents choisiront d'adopter un nouveau moyen de paiement s'ils anticipent que les autres l'adopteront aussi, afin de rentabiliser leur investissement initial pour l'acquisition du nouveau moyen de paiement. Les services en réseau, tels que les paiements électroniques circulant sur les réseaux ouverts, génèrent des effets de réseau (Pénard, 2002). Effectivement, l'utilité des utilisateurs d'un système de paiement électronique augmente avec le nombre d'utilisateurs de ce service. Les consommateurs seront incités à utiliser un service de paiement si le nombre de commerçants acceptant ce moyen de paiement est suffisant et les commerçants seront incités à accepter ce moyen de paiement, et à s'équiper en conséquence, si le nombre de consommateurs utilisant ce service est important.

Enfin, les moyens de paiement électronique innovants ne seraient finalement pas si différents des moyens de paiement traditionnels. A titre d'exemple, la nécessité de pré-payer les instruments de monnaie électronique revient au même mécanisme que de retirer du liquide à un distributeur pour l'utilisateur, qui doit alors arbitrer entre son épargne et sa détention de monnaie électronique et doit faire face au même coût d'opportunité (Schreft and Smith, 2000). Il peut aussi devoir, comme c'est le cas pour la monnaie Moneo, trouver une borne électronique spécifique lui permettant de créditer sa carte (ou outil) électronique. Du côté du payé, le mécanisme est le même que l'usage d'une carte bancaire de paiement. En effet, le payé ne peut ré-utiliser directement la monnaie électronique transférée par l'utilisateur lors d'une transaction. Son compte de monnaie électronique est d'abord crédité avant qu'il puisse utiliser

à son tour cette monnaie (Brack, 2003). Selon Brack (2003), l'usage de la monnaie électronique ne correspondrait donc pas à un réel changement dans les mécanismes traditionnels de transactions, et n'apporterait donc pas une réelle complémentarité aux systèmes traditionnels par leurs usages.

Complémentarité dans les objectifs poursuivis

Si la complémentarité des systèmes de paiement innovants peut être abordée du point de vue des usages, elle peut aussi être envisagée du point de vue des objectifs qu'ils supportent. En effet, certains SPE et monnaies électroniques ont été conçus, par des acteurs bancaires ou non bancaires, afin de remplir des objectifs économiques spécifiques. C'est le cas notamment de deux outils, étudiés plus en détail dans cette thèse, les monnaies complémentaires et la monnaie mobile. Ces deux systèmes innovants de paiements électroniques supportent des desseins sociétaux et sont adaptés au contexte et aux problèmes locaux rencontrés.

Les monnaies complémentaires sont des systèmes de paiement électroniques (parfois non électroniques) développés à l'échelle d'une ville ou d'un quartier (Systèmes d'Echanges Locaux (SEL) tels que le Minuto en Belgique, le NU-Spaarpas (Roterdam), le Bristol Pound, ou le Brixton Pound). Elles sont aussi appelées "monnaies sociales" (Blanc, 2006) de par les objectifs sous-jacents à leur création, ou "monnaies communautaires" (Seyfang, 2004, 2006) de par les communautés d'échanges qu'elles impliquent. Il existe deux formes distinctes de monnaies complémentaires, celles s'échangeant entre particuliers et professionnels (Galleco, Ille-et-Vilaine, France), et celles circulant entre particuliers (SEL). Les systèmes d'échanges locaux (SEL) peuvent être définis comme "une association locale et fermée de personnes mettant des services et des savoirs au service les uns des autres, ces échanges étant mesurés dans une unité d'échange choisie par les adhérents" (Attout et al., 2013). Ces SEL peuvent aussi prendre la forme de banques du temps (le terme anglais Time Banking étant plus fréquemment utilisé), où la monnaie échangée est une unité de temps. Les monnaies complémentaires sont elles définies comme "des dispositifs d'échange locaux

de biens, de services et de savoirs, organisés autour d'une monnaie spécifique et permettant à la fois d'évaluer et de régler les échanges" (Blanc, 2006). Elles sont créées pour dynamiser le développement d'une localité (Bristol Pound, Brixton Pound), promouvoir des producteurs locaux, lutter contre l'exclusion sociale (SEL) ou encore pour défendre des intérêts écologiques (EcoIris, Bruxelles; CitéGreen, Paris). Souvent à l'initiative d'associations locales, les monnaies complémentaires peuvent être échangées entre particuliers mais aussi entre particuliers et commerçants.

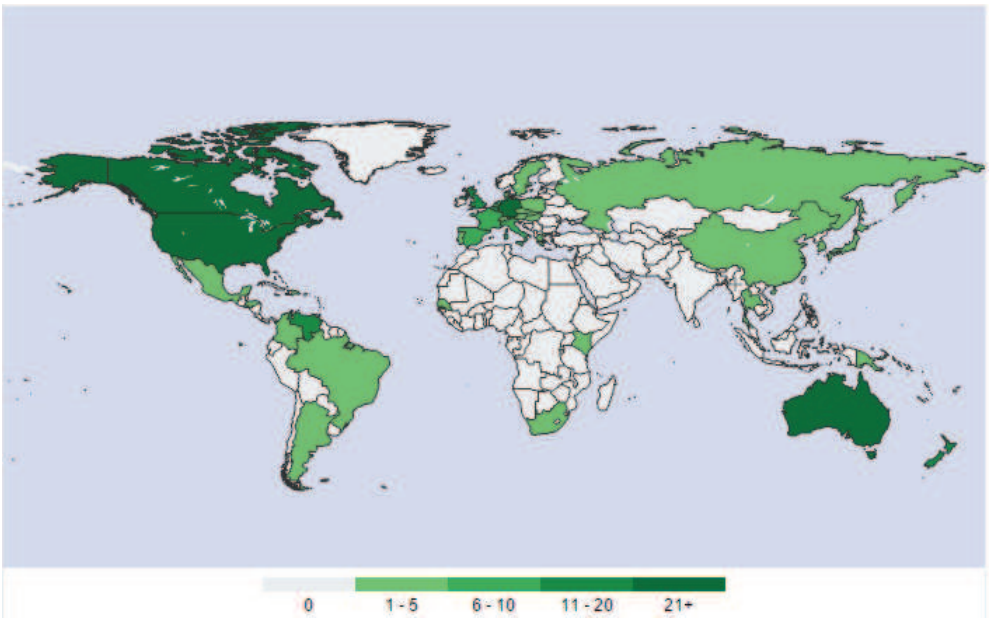

Figure 4: Carte Mondiale des Systèmes de Monnaies Complémentaires (2014) Complementary Currency Resource Center (2014)

Dans le cadre d'une monnaie complémentaire s'échangeant entre particuliers et commerçants, les utilisateurs peuvent dépenser leur monnaie complémentaire dans les commerces partenaires, souvent des producteurs et artisans locaux, tenus à des critères d'exigence en matière de responsabilité sociale et de production soutenable (Blanc et Fare, 2010). Selon les régions, les objectifs recherchés et donc la monnaie complémentaire émise, les consommateurs peuvent l'obtenir par deux moyens principaux. Ils peuvent l'acquérir par la réalisation d'actes éco-responsables, tels que consommer dans des commerces locaux/équitables/écologiques, trier leurs déchets, faire du bénévolat, développer un jardin urbain partagé, etc. C'est le cas notamment de l'EcoIris en Belgique et du NU-spaarpas aux Pays Bas (qui se traduit "maintenant-la

carte incitative"). Les utilisateurs peuvent ensuite utiliser leur monnaie locale pour accéder à des services publics (NU-spaarpas), ou consommer dans des commerces locaux (EcoIris). Ces dispositifs sont alors supportés par les collectivités locales, des acteurs économiques et des banques (Blanc et Fare, 2010), qui participent financièrement, logistiquement, et promotionnellement à ces projets. Ces monnaies complémentaires dites "écologiques" ne sont pas les seules à bénéficier de l'appui des collectivités locales et des partenaires économiques du territoire. En effet, les autres monnaies complémentaires (Galléco, SOL toulousaine) sont aussi soutenues et appuyées. Le développement de la SOL toulousaine a pu s'inscrire dans un programme européen (programme européen EQUAL, financé par le Fonds Social Européen, pour des projets sociaux innovants), et bénéficier ainsi d'un financement public à hauteur de 80% pour son déploiement. Pour acquérir ces monnaies, la logique est un peu différente. Les utilisateurs échangent leur monnaie nationale pour obtenir des unités de monnaie complémentaire. Ils bénéficient alors soit d'une unité de monnaie supplémentaire, soit d'un rabais accordé par les commerçants s'ils effectuent leur paiement en monnaie complémentaire. Cette monnaie est convertible à l'achat pour les consommateurs et convertible à la vente pour les commerçants. Les fonds des utilisateurs sont alors déposés et protégés dans un établissement de crédit partenaire. Dans les systèmes d'échanges locaux (SEL), où les transactions s'effectuent majoritairement entre particuliers, la monnaie est créée lors de l'échange, on parle de "crédit mutuel". Un utilisateur peut donc commencer à échanger avec les autres membres sans avoir vendu, un bien ou un service, au préalable.

Un des objectifs de ces monnaies étant leur circulation et non leur thésaurisation, elles peuvent être fondantes, c'est-à-dire qu'elles perdent de la valeur régulièrement en cas de non-utilisation. Les monnaies complémentaires, malgré leur longévité, peinent encore à être reconnues et encadrées dans les pays où ils sont déployés. En Belgique, diverses réglementations encadrent le fonctionnement des ces monnaies (loi du 3 juillet 2005, loi du 21 décembre 2009), comme la rémunération en monnaie complémentaire, l'imposition des bénéfices réalisés au sein des SEL, la comptabilisation de la TVA ou encore le contrôle d'une concurrence loyale entre

les SEL et les activités professionnelles. En France, il a fallu attendre juillet 2014 (Loi relative à l'Economie Sociale et Solidaire) pour la reconnaissance des monnaies complémentaires circulant déjà depuis plusieurs années dans ce pays. Les monnaies complémentaires sont depuis reconnus en France comme des titres de paiement. De plus, un rapport a été récemment remis à Carole Delga, Secrétaire d'État française chargée du commerce, de l'artisanat, de la consommation et de l'économie sociale et solidaire le 8 avril 2015, "D'autres monnaies pour une nouvelle prospérité" (Magnen et Fourel, 2015), mettant en lumière les bénéfices que présentent ces monnaies et prodiguant des conseils pour les promouvoir et les développer.

La monnaie mobile, mise en place dans les pays émergents et en développement, est également un instrument de paiement promouvant des objectifs sociaux. En effet, la monnaie mobile a été créée afin de lutter contre l'exclusion financière des personnes non bancarisées (on parle de "Mobile Money for Unbanked people (MMU)"). En décembre 2014, on recensait 225 systèmes de monnaie mobile implémentés dans 89 pays, avec 300 millions de consommateurs inscrits et 103 millions d'utilisateurs actifs (Scharwatt et al., 2014). La monnaie mobile a été conçue comme une alternative au système bancaire non inclusif de certains pays et aux transactions en espèces, peu sécurisées et parfois contraignantes (proximité nécessaire entre les échnageurs). De par ces objectifs, elle est déployée majoritairement dans des pays émergents et en développement (Kenya, Ghana, Côte d'Ivoire, etc.), et se concentre principalement dans les pays d'Afrique Sub-Saharienne (53% des services de monnaie mobile se trouvent dans cette région du monde).

La monnaie mobile a été pensée en réponse aux faibles taux de bancarisation et aux taux croissants et importants d'adoption du téléphone mobile dans les pays émergents et en développement (Jack et Suri, 2011). Elle peut être définie très largement comme "un service pour lequel le téléphone mobile est utilisé pour accéder à des services financiers" (GSMA, 2010) ou plus strictement comme "une monnaie électronique [...] qui peut être reliée à un porte-monnaie mobile, qui se réfère à un lieu de stockage numérique de la monnaie électronique développée et implémentée

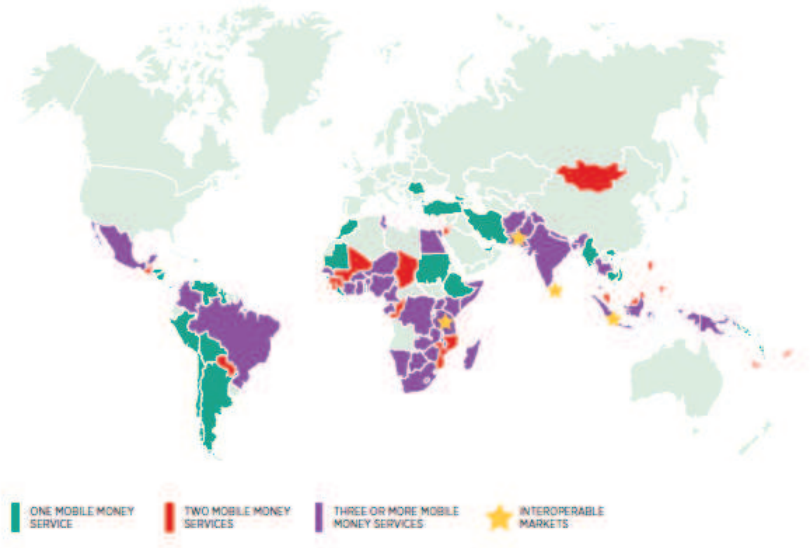

Figure 5: Nombre de services de monnaie mobile existants par pays (décembre 2014)
State of Industry Mobile Financial Services for the Unbanked; Scharwatt et al. (2014)

sur les appareils mobiles, qui permet d'effectuer des transactions de personnes à personnes (P2P) entre deux appareils mobiles (M2M)" (Diniz et al., 2011). Elle est un système de paiement électronique pré-payé, accessible aux personnes non bancarisées, permettant à ses utilisateurs d'accéder à des opérations financières de base (paiements, transferts de personne à personne, retraits, dépôts). Ces monnaies mobiles peuvent être émises à la fois par des organismes bancaires et par des organismes non bancaires, grâce à une réglementation financière de plus en plus clémente permettant à des acteurs non bancaires d'émettre de la monnaie mobile dans 47 des 89 pays où elle est déployée (Scharwatt et al., 2014). Le fonctionnement de la monnaie mobile présente l'intérêt d'être facile d'accès et d'usage. En effet, pour ouvrir un compte, les utilisateurs doivent se rendre dans des boutiques du fournisseur de service, des commerces partenaires, ou des agences bancaires, selon l'entité émettrice de la monnaie mobile. Ce réseau de partenaires facilitateurs est appelé le réseau d'agents. L'ouverture du compte ne nécessite très souvent que la présentation d'un papier d'identité et ne requière pas de dépôt minimum. L'ouverture et la gestion du compte de monnaie mobile sont gratuites, seules les opérations (transferts, retraits) sont facturées à l'utilisateur. Ceux-ci peuvent alors déposer et retirer des liquidités, envoyer de l'argent à une autre personne même non utilisatrice du système, lier son compte bancaire à son compte de monnaie mobile, et payer des commerçants

et certains services publics. La prestation du servide de monnaie mobile s'établit autour d'un écosystème de plusieurs acteurs, tels que des opérateurs téléphoniques ou des fournisseurs de paiements électroniques, des banques, des partenaires technologiques, des fournisseurs d'envois internationaux de fonds. Les partenariats entre les émetteurs de la monnaie mobile et les banques sont fréquents et permettent aux utilisateurs de lier leur potentiel compte bancaire avec leur compte de monnaie mobile (M-Kesho), et forment même parfois des co-entreprises pour la fourniture du service (Tcho Tcho, co-entreprise créée par Digicel et Scotiabank en Haiti). De même, les émetteurs de monnaie électronique s'allient souvent avec des partenaires technologiques qui mettent à disposition leur plateforme technologique permettant d'interconnecter les acteurs de l'écosystème pour les services de paiements et de commerce mobile (partenariat entre Monitise et Telefonica) et offrant une interopérabilité des systèmes de paiement existants (partenariat entre Visa et Airtel en Afrique pour la distribution de cartes électroniques aux utilisateurs rendant la paiement possible des détenteurs d'un compte Airtel dans les points de vente acceptant la Mastercard Visa). Cependant, l'interopérabilité des systèmes de Mobile Money reste encore à construire et rares sont les exemples de tels partenariats, tous encore très récents (interopérabilité entre les services de monnaie mobile d'Orange et Airtel entre la Côte d'Ivoire et le Burkina Faso, 2015; interopérabilité en Tanzanie des services de Vodacom et Tigo, 2015). Les modèles d'affaires de la monnaie mobile peuvent être de différentes sortes (Chaix, 2013; Chaix et Torre, 2015), selon l'entité émettrice de la monnaie mobile, contrainte ou non par les réglementations en vigueur dans le pays où elle est installée. En effet, l'émission de monnaie électronique et l'offre de services financiers mobiles ne sont pas toujours ouvertes aux acteurs non bancaires. C'est le cas au Bangladesh, où seuls les organismes bancaires sont autorisés à proposer de la monnaie mobile aux utilisateurs, et doivent obtenir de surcroît une licence séparée pour offrir ces services, et du Népal où seules les banques commerciales et de développement ont le droit d'émettre une monnaie mobile. Dans les pays où les acteurs non-bancaires sont autorisés à offrir cette monnaie mobile, la réglementation impose au minimum le dépôt des fonds des utilisateurs dans un ou plusieurs établissements bancaires, à l'instar de la réglementation éditée par la BCE.

Problématique

Le centre d'intérêt principal de cette thèse se situe au niveau des systèmes de paiement complémentaires circulant via le téléphone mobile de leurs utilisateurs. Les systèmes de paiement étudiés ont été introduits à l'initiative d'acteurs privés non bancaires et visent à remplir des objectifs économiques spécifiques. Cette thèse s'intéresse tout particulièrement aux conditions d'émergence, de viabilité, et d'efficacité de ces monnaies mobiles sociales. Il s'agit de comprendre, tant par leur mise en place, leur diffusion et leur utilisation, comment ces alternatives peuvent rejoindre les objectifs économiques qui sous-tendent à leur émergence. L'impulsion privée à la création de ces nouveaux moyens de paiement, impulsion associative et/ou entreprenariale, a posé la question de la compatibilité des ces intiatives avec les objectifs sociaux supportés. Cette thèse propose d'identifier les caractéristiques de ces nouveaux moyens de paiement et les conditions nécessaires à leur déploiement et à leur développement. De plus, elle propose d'évaluer l'adéquation de ces conditions avec les avancées sociétales supportées. Enfin, il s'agira de comprendre les conditions d'émergence des plateformes technologiques supportant ces innovations et d'analyser leurs fateurs de succès.

Cette thèse se décompose en trois chapitres distincts analysant successivement :

- les conditions d'émergence, de viabilité et d'efficacité des systèmes d'échanges locaux au sein desquels circule une monnaie complémentaire;
- les conditions nécessaires d'implémentation et d'adoption de la monnaie mobile et leur adéquation avec les objectifs économiques poursuivis par son déploiement;
- les conditions d'émergence essentielles à l'élaboration des plateformes technologiques permettant le déploiement et la diffusion de monnaies mobiles sociales.

Chapitre 1

Les monnaies mobiles complémentaires sont des moyens de paiement électroniques alternatifs supportant des objectifs économiques spécifiques, tels que le développement local et la lutte contre l'exclusion sociale. C'est le cas notamment des systèmes d'échanges locaux (SEL), communautés d'échanges de biens et services à l'aide d'une monnaie complémentaire, étudiés dans ce premier chapitre. Les SEL s'adressent essentiellement à des personnes à faible revenu (retraités, chômeurs) et proposent un "crédit mutuel" aux membres de ces communautés leur permettant d'initier des échanges sans avoir à vendre des biens ou des services au préalable. Dans ce chapitre, un modèle à la Pissarides est utilisé pour étudier le cas particulier d'une monnaie mobile complémentaire circulant au sein d'un SEL et ses retombées sur ses utilisateurs. Ce modèle repose sur deux hypothèses principales. Tout d'abord, les SEL permettent à leurs utilisateurs d'éviter la double coïncidence des besoins recontrée lors du troc. De plus, ils aident leurs membres à maintenir et à développer leurs compétences lors de périodes de chômage, et ainsi à conserver un niveau d'employabilité suffisant même après une longue période d'inactivité. En effet, les travaux en économie du travail révèlent que les chômeurs ont tendance à perdre une partie de leurs compétences spécifiques (relatives à leur précédent emploi) lors de périodes de chômage. Plus ces périodes sont longues, et plus les compétences spécifiques des travailleurs se dégraderont. De plus, les chômeurs de longue durée ont tendance à être stigmatisés par les employeurs qui préféreront toujours employer des chômeurs de court-terme ou des personnes en activité. Une des solutions à cette dégradation des compétences des chômeurs est la pratique de leur activité durant leur période de chômage. Les SEL leur offriraient donc l'opportunité de pratiquer leur activité même durant une période de chômage et ainsi de maintenir leurs compétences et leur employabilité. Dans le modèle élaboré, les agents ont tous un niveau de confiance préalable vis-à-vis du SEL, relatif à leur utilité espérée retirée de leur participation à un SEL. Ce niveau de confiance initial apparaît comme un élément crucial pour l'émergence et la pérennité du SEL. De plus le niveau de crédit accordé aux membres pour soutenir leurs échanges s'avère d'un usage à double tranchant. Il permet effectivement d'initier les échanges des membres sans qu'ils aient à vendre préalablement, ce

qui fluidifie les transactions et rend le SEL plus actif. En revanche distribué sur des bases trop élevées, il finit par désinciter les agents à produire, ce qui nuit au maintien de leurs compétences et à l'amélioration de leur employabilité. La circulation d'une monnaie complémentaire au sein d'un SEL a alors une influence différente sur le niveau d'emploi et le bien-être des agents.

Chapitre 2

Les monnaies mobiles déployées dans les pays émergents et en développement sont conçues comme une alternative au système bancaire et aux outils de paiement traditionnels. Elle ont pour but de lutter contre l'exclusion financière en offrant à des personnes non bancarisées l'accès à des services financiers à faible coût (dépôts, retraits, transferts de fonds, paiements) accessibles par le biais de leur téléphone mobile. Cependant, la littérature sur la monnaie mobile, encore largement alimentée par des practiciens, relève des incohérences entre les objectifs de cette monnaie et les conditions préalables nécessaires pour l'implémentation et l'adoption de ces services financiers. En effet, la nécessité d'un système bancaire relativement efficient et inclusif serait un facteur clef de l'implémentation et la diffusion de ces monnaies, ce qui ne coïncide pas avec les objectifs promus. Partant de ce constat, l'objectif de ce chapitre est d'analyser les déterminants à l'origine de la localisation de l'offre des fournisseurs de monnaie mobile d'une part, et les facteurs d'adoption de ces services d'autre part. Dans un premier temps, ce chapitre propose d'identifier et de comprendre les déterminants macroéconomiques des choix d'implémentation des fournisseurs de service. Il s'agit de déterminer les conditions nécessaires au déploiement de la monnaie mobile et d'évaluer si ces consitions coïncident avec les objectifs économiques recherchés. Pour cette première analyse, 83 pays émergents et en développement, cibles de ces nouveaux services, sont étudiés de 2004 à 2012, période d'émergence de la monnaie mobile. Pour évaluer le potentiel d'inclusion financière de la monnaie mobile, ne sont observés que les services développés par des organismes non bancaires ne nécessitant pas l'ouverture d'un compte bancaire. Un modèle Probit avec une correction à la Mundlak (1978) est appliqué aux déterminants d'implémentation de la mon-

naie mobile dans les pays émergents et en développement, étudiés selon leur niveau de revenu. Dans un deuxième temps, ce chapitre se concentre sur la compréhension des facteurs macroéconomiques favorisant l'adoption de la monnaie mobile dans 35 pays ayant bénéficié de l'offre de ces services. Il s'agit d'évaluer l'adéquation entre les conditions nécessaires aux prestataires de services pour implémenter leur monnaie mobile et la demande (les besoins des utilisateurs). Une analyse statistique de classification ascendante hiérarchique des données est réalisée sur les facteurs d'adoption de ces services. Les résultats de ce chapitre montrent premièrement que les fournisseurs de monnaie mobile sont encore dépendants du système bancaire en place dans le pays, autant du point de vue de la disponibilité des infrastructures bancaires que de la connaissance financière préalable des potentiels utilisateurs. Ces conditions nécessaires à l'implémentation de la monnaie mobile sont contraires à l'objectif promu par la mise en place de ce nouveau service financier et conduisent à une double exclusion des pays les plus faiblement bancarisés. De plus, si les pays où la monnaie mobile est la plus adoptée sont effectivement des pays souffrant d'exclusion financière, ce ne sont pas les pays où celle-ci est la plus importante. Ce constat confirmerait dans un deuxième temps la nécessité d'une préalable connaissance et expérience des services financiers pour garantir l'adoption et la diffusion de la monnaie mobile. Ces inadéquations révèlent la nécessité pour les fournisseurs de services d'étendre leur réseau interne d'agents facilitateurs et de nouer des relations extérieures pour développer des coopérations plus larges avec les acteurs économiques. En effet, si la réglementation prudentielle, aussi conciliante soit-elle, envers les émetteurs de monnaie mobile, ne leur permet pas de réduire leur dépendance vis-à-vis du système bancaire pour gérer leurs liquidités, ceux-ci doivent trouver des solutions afin de favoriser la dématérialisation des échanges des utilisateurs. Nouer des relations avec les collectivités et les partenaires économiques locaux permettrait d'encourager l'indépendance des consommateurs vis-à-vis des espèces. De plus, la nécessité d'une préalable connaissance financière pour l'adoption des services financiers innovants fait apparaître l'importance du développement de réseaux d'agents facilitateurs jouant un rôle primordial dans l'information et l'éducation des personnes non bancarisées.

Chapitre 3

Cette thèse a été conçue et financée dans le cadre du projet FIRST (Financial Inclusion based upon Rural mobiquitous Services Technological platform) qui vise à concevoir une offre de service permettant de résoudre des problèmes d'exclusion et de non bancarisation de la population rurale en Inde. Ce projet mobilise quatre acteurs dans le cadre d'un projet collaboratif : Tata Consultancy Services (TCS), l'Indian Institute of Science de Bangalore (IISc) le Master MBDS de l'Université Nice Sophia Antipolis (UNS) et GEMALTO. Plus précisément, FIRST vise à déployer une plateforme générique permettant dans un premier temps de résoudre d'importants problèmes de fonctionnement du système d'aide alimentaire mis en place par le Gouvernement Indien, le Public Distribution System (PDS), pour évoluer, dans un deuxième temps, vers la conception d'offre de services virtuels destinés à bancariser la population indienne localisée en zone rurale. Du point de vue technologique, FIRST repose sur un important enjeu : rendre interopérable deux solutions émanant d'infrastructures industrielles différentes (infrastructure bancaire et infrastructure de télécommunication mobile). Cette convergence sectorielle pose de nombreuses interrogations à la fois en matière de positionnement stratégique des acteurs d'un tel écosystème, mais aussi du point de vue du business model des services proposés. L'objectif ici est de développer un système générique à base de technologie NFC permettant la distribution d'un ensemble de services bancaires via un support d'accès à la portée de la population indienne non bancarisée et localisée en zone rurale : le téléphone mobile. Cette recherche met l'accent sur les conditions relatives à l'élaboration d'une plateforme technologique dans l'objectif d'identifier quelle en est, ou quelles en sont, les composantes clefs structurant l'émergence d'un écosystème d'affaires. Elle mobilise pour cela la théorie de l'innovation architecturale. Elle s'inscrit dans une démarche de recherche abductive par l'observation participante et propose une grille d'analyse utile à l'identification des prérogatives essentielles à la construction des plateformes technologiques. Testée dans le cadre d'une étude de cas contemplative, cette grille d'analyse permet de montrer comment la dimension

relationnelle des connaissances architecturales facilite l'élaboration des plateformes technologiques de type supply chain dont l'évolution vers la forme industrielle relève en revanche des trois autres dimensions des connaissances architecturales. Du point de vue managérial enfin, cette grille d'analyse facilite aux praticiens l'identification de leur positionnement stratégique et leur rôle dans le processus de conception d'une plateforme technologique. En effet, la question de savoir comment, sous quelles conditions et dans quel objectif une plateforme émerge, est fondamentale à l'analyse de la naissance d'un écosystème d'affaires et au positionnement stratégique des acteurs membres. A travers cette problématique, nous nous intéressons au processus de conception de la plateforme et à l'identification de l'élément qui consacre un acteur membre leader.

Chapter 1

Mobile complementary currency systems: employability and welfare

1.1 Introduction

According to the estimations of The World Payments Report in 2012, using dematerialized ways to exchange money is still increasing and even growing faster than the volume of dematerialized exchanges previously forecasted. The number of online payments achieve a growth of 20% a year between 2009 and 2013, and this forecasted growth is faster for m-payments (payments with a mobile phone) reaching 52,7% a year during the same period around the world. It is generally considered that mobile payment transaction volumes will be more important than credit card payment volumes in the early twenties (World Payments Report, 2012).

At the same time, alternative currency systems continue to develop: LETS and SEL in France which are local exchange trading systems; the Time Banks which is a complementary currency based on the time of services exchange; the SOL in France which is a local currency exchanged between citizens and local producers; NU-Spaarpas in Nederland and Eco-iris in Belgium which are ecological currencies; etc. There are currently 4000 in circulation around the world, and 60 in circulation or planned in France (Lejeune L., 2013).

They take two forms: a material form (cash, SOL or bonds, SEL) or an immaterial one (centralized credit/debit systems, LETS), and they have their own characteris-

tics:

They are only devoted to private transaction (Time Banks, SEL) or open to business transactions (SOL). They usually make possible multilateral uses: in this case, a credit line is created after the first transaction and this credit can circulate on further exchanges (SEL, Time Banks, LETS). Usually, they take the form of complementary currency convertible in national currency (SOL) or inconvertible (SEL), the currency storage can regularly decrease (Trueque in Argentina) or be charged, and incomes obtained from these systems can be submitted at the same regulations that the formal incomes (LETS). They can also offer systematic credit to the users (LETS).

The development of such currencies is encouraged from many years by the development of online communities. The more recent development of mobile applications available on mobile-phones and smart-phones offers new possibilities to use these currencies in mobile payments and transfers. Some of them have already been exploited inside local communities: we can easily predict that these experiences are only at their initial phase and that they will develop as rapidly than the rate of penetration of mobile services next years. Till now, these communities take the form of local official or informal associations (Blanc, 2005). Inside these communities, the circulation of the parallel money promote interactions between new agents, the so-called “prosumers”, who are both producers and consumers (Blanc, 2006).

A complementary currency is named ”social currency” if it reaches three goals: localizing exchanges, boosting exchanges into the locality and transforming the nature of exchanges (Blanc, 2006). A social currency is “an exchange system of goods, services and knowledge organized by and for small communities by ad hoc organizations. The community can take form of association of persons, formal or informal” (Blanc, 2005).

These social currencies, which are a subset of the set of parallel currencies, have generally been created in order to promote and develop local environment and economy and to fight social exclusion, compensating the lack of money of their users

(Seyfang, 2002; Blanc, 2006). The new systems of payment generated by these communities do not require any banking account and can then be used by non-banked people. These alternatives currencies are then aimed to help low income people to reach / maintain a minimal level of consumption. It has indeed been frequently observed that, despite the existence of ratchet effects, real or forecasted income fall during the periods of unemployment (Browning and Crossley, 1997, 2000). Results of surveys realized on LETS and Time Banks in UK and in United-States show that low-income and unemployed users are effectively the target audience of these parallel systems of payment (Seyfang, 2001, 2002, 2003; Collom, 2011; Lasker et al., 2011).

Indeed, a survey realized in 2006 on a Time Bank system in United-States reveals that one-third of respondents have annual household incomes of less than $20,000 (Collom, 2011) and a survey realized in UK in 2002 reveals that 80% of Time Banks users are unemployed people and 70% live with less £13,000 by year (Seyfang, 2003).

While the development of mobile technology improves the potentiality to develop efficient social currencies, it is then relevant to ask if this kind of parallel currencies, could achieve their goals: fighting social exclusion and unemployment ?

Surveys realized in communities using a complementary currency identify the possible links between community currency membership and employment by examining the opportunities opened up by taking part in local exchange systems.

Local currency communities are not known for creating jobs. The jobs directly created by the system and indirect links between these systems and employability. A survey realized in a LETS in UK reveals that only 4.9% of surveyed members have obtained a job directly through the LETS because organizers of the community are principally volunteers (Williams et al., 2001). Except some social monies created in order to get job to unemployed workers, like the township-currency of Woergl in Tirole in Austria (Gelleri, 2009), local currency communities don't formaly create jobs. If they don't, how can they help unemployed workers to re-enter the job market?

During the unemployment period, people can suffer of irreversible damages concerning a loss of motivation and a depreciation of skills (Mincer and Ofek, 1982; Pissarides, 1992; Böheim and Taylor, 2002; Edin and Gustavsson, 2008). This issue is also evocated in the "scar theory" which indicates that a long-term spell of unemployment can conduct to a depreciation of human capital (Heckman and Borjas, 1980, in Flaig et al., 1993). Unemployed are not able to maintain and improve his valuable work experience and his knowledge. These damages on human capital will have long-term effects on the worker employability that implied a "state dependence" for unemployed people. It means that being unemployed and having been experienced a long period in unemployment decrease their probability to find a job in the future (Flaig et al., 1993). That's why it exists some "hysteresis effects" in unemployment. The first effect is issue from the spell length of unemployment. More the spell of unemployment is length, more human capital is lost, and more the probability for unemployed to find a job is low. Employers will prefer to not hire long-term unemployed due to this human capital depreciation. The second hysteresis effect takes place during periods of falling employment. Short-term unemployed, judged "more competitive", than long-term unemployed, are more likely to be hiring. Even in healthy labour market period, unemployed person have difficulties to re-enter the labour market because employers prefer hire employees and short-term unemployed. There are some permanent hysteresis effects, due to loss of skills and due to stigma from employers to long-term unemployed, which implied that long-term unemployed are less likely to find a job (Bourdet and Persson, 1991, 1991a).

However, this loss of skills during unemployment is not a fatality. Productivity of an employee is related to specific competences used for a specific job. This productivity is increasing during employment helped by informal or formal training. More the employee stays in job, more he becomes "familiar" and competent in his job until he reaches a top point of productivity (maximum productivity). If the employee loses his job, he gradually losses these specific competences which was improved by time spent on job. But, these competencies, once acquired, are not totally lost. Once re-employed, the employee re-learns and re-reaches his maximum

productivity. Nevertheless, more the time spent in unemployment is lengthy, more it will be lengthy to re-learn specific skills related to his job. There are factors which determine the timeliness of skill loss: the length of time spent in employment (more the time spent in a specific job is lengthy, less the skills are losing quickly), the nature of skill used (some skills are more easily lost), and if the employee has used this skill during the spell of unemployment (Johnson and Van Doorn, 1976). This idea of learning during employment spell is also presented in the "learning by doing" theory. Workers learn from experiences. The amount of skills accumulated is positively correlated with time spent in activity and his depreciation is positively correlated with non-use of it (Killingsworth, 1982; Mincer and Ofek, 1982; Desjardins and Warnke, 2012).

If these specific skills can be maintain and actualized by "traditional" training and internship programs during the spell of unemployment (Bourdet and Persson, 1991), there is another way. As seen previously, communities using a social currency don't formally create jobs. However, they can improve the individual employability. To join these communities, members need to procure a good or a service to sell to other members. To produce this good or service, they need cash in order to launch their activity. Even if in some communities members can obtain a credit in community currency, unemployed people remain ressourceless (credit offered by the community can be insufficient to launch an activity and unemployment benefit is usually used for current consumption). That's why they will offer to other members an activity, essentially services, related to their previous job, activity for which they have required skills and for which they don't have to invest in order to create the service. Launching a new activity (or a secondary activity), not related to the previous job, would be risky for unemployed people because it would require costly material and immaterial investments with no guarantee of return on investment (Peacock, 2000). By offering an activity related to their previous, unemployed people have the possibility to maintain and actualize their specific skills and, in this way, improve their employability. Communities using their own currency are surroundings to develop a sort of self-employment jobs - or to serve as a springboard

for access to self-employment (Gomez and Helmsing, 2008; Williams et al., 2001). Unemployed people transform their specific competences in revenue and purchasing power without risks encountered by launching a formal self-employment activity: no administrative and accounting burdens, the customer base is already composed by community's members, the LETS gives the opportunity to assess the relevance of the activity.

Loss of skills is not the only problem that unemployed people need to confront. With job loss, unemployed tend to lose their social network. As a consequence, they lose a part of information particularly about job opportunities and new activity development (Williams, 1996). Communities using a social currency could help unemployed people to re-create a social link. Thanks to surveys conducted on members of community currency exchange systems, this help is revealed real. Community currency exchange systems give them opportunity to re-construct and to extend their social network (Williams, 1996; Seyfang, 2001) and know more local people (Seyfang, 2003), to belong in a collectivity (Lasker et al., 2011), to again participate actively in the life of their community with help of coordinators who bring members together (Seyfang, 2002), and to develop relationship skills (Seyfang, 2001; Ozanne, 2010).

In a first attempt, which has been concluded by a scientific publication (Della Peruta and Torre, 2015), the effects of a mobile currency circulation inside a local community of unemployed people are analysed. In this Pissarides-style theoretical model, participating on a social currency system enables unemployed workers to maintain their skills, avoiding human capital depreciation occurring during unemployment spell, and to preserve and extend their social network. A benchmark setting is presented with two possible positions for unemployed workers: short term unemployed workers have a higher instantaneous probability to find a job than long term ones. Then, a LETS is introduced having two properties: (i) to improve, thanks to the complementary currency, the potentiality to exchange goods and services in the informal sector, and (ii) to maintain professional skills outside job. Trust

in the mobile complementary currency outside LETS and inside LETS are crucial to make LETS permanent (to avoid LETS collapse). When LETS are permanent, they increase employment, the level of expected utility of employed workers, and are Pareto-improving when compared to the benchmark case without LETS. This model considers a LETS in which only unemployed workers participate, because of their available time during their unemployment spell. It is too simple to study LETS' benefits from inside. In fact, effective properties of the LETS were taken as an exogeneous parameters and only the lack of confidence in the properties of the LETS explains that the LETS could fail. Finally, this doesn't take into some characteristics of participating in a LET: for instance, members don't support costs of production to produce their goods or services and they don't have access to the mutual credit, often granted to LETS members, with the good and bad effects of this micro-credit availability.

The scope of this chapter is to go beyond this first attempt and to explore the influence of social mobile currency circulation between – unemployed and employed – members of a community on job market and employed workers welfare through benefits resulting of exchanges into this community on employability and social links of unemployed workers. Employed and unemployed workers exchange each other services and goods for an extra income/utility. To offer these products, they need skills and competences, and particularly that are related to their job or previous job (Peacock, 2000). We assume that this maintained activity by long-term unemployed workers during their unemployment spell dampens the loss of skills and productivity during unemployment spell referred to by the literature (Mincer and Ofek, 1982; Pissarides, 1992; Böheim and Taylor, 2002; Edin and Gustavsson, 2008) and reduces the long-term unemployed workers probability to remain unemployed (Flaig et al., 1993). In addition, members can benefit form a mutual credit to begin transactions before selling goods and services. Members can buy products with an acknowledgment of debt, as introduced by Diamond in search-models (1987, 1990). These micro-credits improve LETS fluidity of exchanges, softening the cash-in-advance constraint. If credit facilitates transaction in the LETS, it can also reduces LETS'

members effort to produce goods or services. A too large amount of credit enables them to buy into the LETS without having to sell their production, and then without having to produce which is the key to their employability.

With these assumptions, we ask three research questions:
(i) on which condition such LETS can maintain or not at equilibrium? (ii) Which is the influence of mutual credit on LETS objectives achievement? Which is the influence of such LETS on the level of employment? (iii) What is the effect of LETS on welfare?

1.2 The benchmark model

The benchmark model presents an economy with n workers where the probability to observe employment opportunities decreases during the time each worker stays unemployed. To simplify the setting we suppose that the in the economy, workers can take three possible positions:

- Employed workers are in proportion e of the total active population. They earn the periodic wage w and have the probability q to lose their job at the end of the period.

Unemployed people distribute in two sub-categories.

- Short-term unemployed workers are in proportion s: they receive the unemployment benefit b and have the probability $\alpha^{'}$ to find a job during the current period. If they do not observe an opportunity of employment, they integrate the group of the long-term unemployed workers.

- Long-term unemployed workers are in proportion l. They receive the same unemployment benefit b than the short-term unemployed ones but their probability to observe an opportunity to work is only α with $\alpha < \alpha^{'}$.

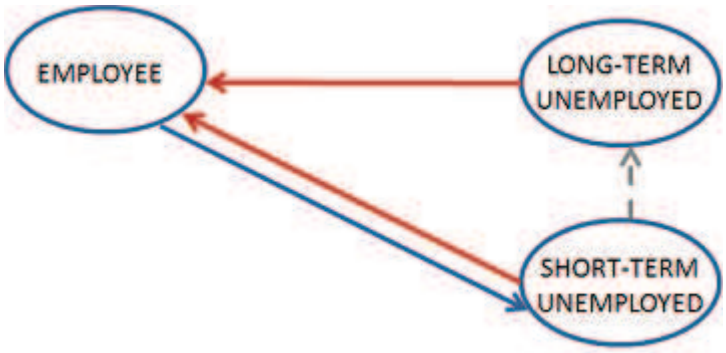

Figure 1.1: Transition pattern in the benchmark model

The model is analyzed at stationary equilibrium, i.e. the state such that the number of employed and unemployed workers remains constant during time, once the environment remains unchanged. The stationary equilibrium equations are (1.1), (1.2) and (1.3):

The stationary level of employment is deduced from the conjunction of the Bellman equations and the stationary equilibrium equations which express as 1.1

$$qe = \alpha^{'} s + \alpha l \tag{1.1}$$

$$qe = s \tag{1.2}$$

$$(1 - \alpha^{'})s = \alpha l \tag{1.3}$$

with by definition, $e+s+l = 1$. Solving the system gives the equilibrium level of employment $e = \frac{\alpha}{q(1-\alpha^{'})+\alpha(1+q)}$. Studying in comparative statics this expression shows that employment increases with the capacity to find a new job in each position of the job market, and with a decrease of the rate of destruction q of existing employment positions. Long term unemployed workers are in proportion $l = \frac{q(1-\alpha^{'})}{q(1-\alpha^{'})+\alpha(1+q)}$. A comparative static analysis shows that their number increases with the increase of the rate of attrition q of jobs and decreases with an increase of the capacity to find a job as short term or long term unemployed worker.

The intertemporal utility associated with each position after consumption is deduced from the Bellman equations (1.4) to (1.6)

$$V_e = (1-q)\,\frac{w+V_e}{(1+r)} + q\,\frac{b+V_s}{(1+r)} \tag{1.4}$$

$$V_s = \alpha'\,\frac{w+V_e}{(1+r)} + (1-\alpha')\,\frac{b+V_l}{(1+r)} \tag{1.5}$$

$$V_l = \alpha\,\frac{w+V_e}{(1+r)} + (1-\alpha)\,\frac{b+V_l}{(1+r)} \tag{1.6}$$

where V_e, V_s and V_l figure respectively the intertemporal utilities of an employed worker, a short-term unemployed worker and a long-term unemployed one, after consumption while w and b represent respectively the instantaneous wage of an employed worker and the unemployment benefit of an unemployed worker. The system (1.4) to (1.6) also solves and gives the equilibrium values of the intertemporal utility in each position that a worker can occupy on the labor market. The instantaneous components of their utilities are respectively given by the monetary value of wages w and of the unemployment benefit b. The system solves easily. Each intertemporal utility is a function of the parameters q, α, α' but also w and b. The study of V_e, V_s and V_l in comparative statics states that (see Appendix 1) each intertemporal utility increases with w, b, α and α' and decreases when q increases. All these relations are intuitive: smaller is the probability of a worker to be fired, greater is his utility in each position of the job market. The same intuition is confirmed concerning the influence of the potentiality to be hired when unemployed and utilities. The other relations comparative statics properties have also intuitive contents.

1.3 Introducing a LETS

A LETS is introduced in this section as a network in which goods and services are produced and sold between individuals members. Products are exchanged with an

electronic complementary currency and members benefit form a "mutual credit" enabling them to begin trading without first selling goods and services.

The LETS provides the possibility to exchange informally services among members, without being limited by the "double coincidence of needs" condition. The complementary currency then increases the efficiency of the informal sector. Members can earn a profit by selling goods and services inside the LETS, but they have to bear a production cost to produce these goods and services. In addition, this profit is related to the time they can make available to produce inside the LETS. The instantaneous benefit from being unemployed is not anymore b, the unemployment benefit. By now, the benefit from being an unemployed worker inside the LETS increases from b to $b + a_u(b' - c)$, where b' is the profit earned by selling goods and services inside the LETS, c is the production cost to produce these goods and services, and a_u a coefficient capturing the time that unemployed workers can make available to produce inside the LETS. To make LETS relevant, we suppose $b' > c$. Similarly, the instantaneous benefit from being an employed worker inside the LETS increases from w to $w + a_e(b' - c)$, where a_e captures the time that employed workers can make available to produce inside the LETS, which is reasonably smaller than a_u.

Additionally, the LETS offer a mutual micro-credit to its members, representing an advantage in the sense that this credit permit to introduce a delay between consumption and production and/or spellings. In a simplifying way, we consider this direct advantage $a''C$ as linear and additive on members instantaneous utilities.

The use of a complementary currency is however nothing but evident for workers more able to accept barter then to trust a private system of intermediation eventually founded on the capacity of other unemployed workers to accept as payment this complementary currency. Outside LETS, workers have heterogeneous levels of confidence in the properties of the complementary currency and in the potentiality of the LETS in general. Suppose as a working assumption that the levels of confidence of employed workers on the reliability of the complementary currency are

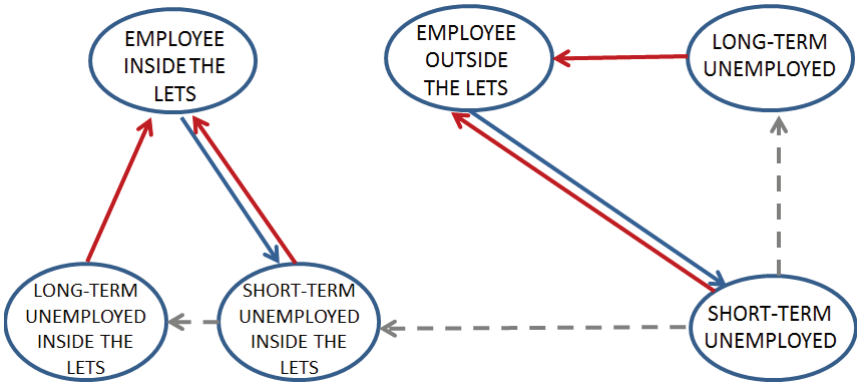

Figure 1.2: Transition pattern in the LETS model

then given by a coefficient λ_i defined on a segment $[0, \bar{\lambda}]$. This confidence on the reliability of the complementary currency circulating affects workers' expectations on their capacity to earn profits inside the LETS. According their level of confidence λ_i, they will anticipate a greater or lesser profit, and decide to participate or not in the LETS. When λ_i is close to 0, worker i has a low level of confidence into the complementary currency and the potentiality of the LETS to modify her purchasing power. When λ_i is close to $\bar{\lambda}$, this level of confidence is conversely high. As $\bar{\lambda}$ can be greater than 1, there could be under and over-confidence.

Then, the expected instantaneous benefit from being a member of the LETS can be expressed as follows:

$$A = b + a_u(\lambda_i b' - c) + a'' C \tag{1.7}$$

where A expresses the expected instantaneous benefit from being an unemployed worker inside the LETS.

$$B = w + a_e(\lambda_i b' - c) + a'' C \tag{1.8}$$

where B expresses the expected instantaneaous benefit from being an employed worker inside the LETS.

With the introduction of the LETS, when an employee loses his/her job, he/she

becomes a short term unemployed worker. He/she can be recruited again immediately or not. If he/she remains unemployed, he/she can decide to joint the LETS instead of becoming a long term unemployed worker[1]. People outside the LETS do not know exactly the advantages and disadvantages of the LETS. They then compare the advantages of being inside or outside LETS as long terms unemployed workers according their respective levels of λ_i. Only unemployed workers rather optimist on the properties of the LETS then tend to integrate the LETS. These unemployed workers correspond to the highest values of λ_i. Namely, short term unemployed workers not recruited immediately choose to integrate or not the LETS according the comparison of V_l given by expression (1.6) and their expected value of the same position V_{ll} inside the LETS. This value is obtained as a solution of the following system:

$$V_{ll}(\lambda_i) = (\alpha + a'''(\alpha' - \alpha) - \gamma C^2)\frac{B + V_{el}(\lambda_i)}{1+r} + (1 - (\alpha + a'''(\alpha' - \alpha) - \gamma C^2))\frac{A + V_{ll}(\lambda_i)}{1+r} \quad (1.9)$$

$$V_{el}(\lambda_i) = (1-q)\frac{B + V_{el}(\lambda i)}{1+r} + q\frac{A + V_{sl}(\lambda_i)}{1+r} \quad (1.10)$$

$$V_{sl}(\lambda_i) = \alpha'\frac{B + V_{el}(\lambda i)}{1+r} + (1-\alpha')\frac{A + V_{ll}(\lambda_i)}{1+r} \quad (1.11)$$

The term $\alpha + a'''(\alpha' - \alpha) - \gamma C^2$ of equation (1.9) encapsulates two different effects. The first on, associated with the term $a'''(\alpha' - \alpha)$ expresses the expected gain in employability associated with working in the LETS, then maintaining skills environment closed adaptation to short term unemployed people. The term γC^2 refers to bad consequences of the availability of credit on unemployment. Credit decrease the incentive to work inside LETS and the limit the gain in employability of long term unemployed people inside the LETS.

[1]We suppose that time and voluntary actions necessary to apply to the LETS limit the possibilities to integrate them during unemployment time. We will also show further that there is no interest for an unemployed worker to apply a LETS immediately after being fired nor as a long term unemployed worker

Solving separately the systems (1.4)-(1.6) and (1.9)-(1.11) provides the values of V_l and V_{ll} which provide - when equalized - the threshold value λ_i^* of λ_i. The following proposition then studies the comparative static properties of λ_i^*.

Proposition 1. *The number of unemployed workers choosing to join a LETS increases with* $\bar{\lambda}$*, with* α' *and decreases with* $(\alpha' - \alpha)$*. It is not still monotonous with* C*.*

Proof: Given λ^*, the size of the population introducing the LETS is given by $t = \frac{\bar{\lambda}-\lambda^*}{\bar{\lambda}}$. (see development the expression of t^* for the non-negative values of the different populations of employed and unemployed workers, inside and outside the LETS in Appendix I). Elementary comparative static analysis provides the rest of the lemma ■

Some of these results are intuitive. For instance, given that workers are uniformly distributed on the segment $[0, \bar{\lambda}]$, higher is $\bar{\lambda}$, greater is the number of agents choosing to integrate the LETS. Increasing $\bar{\lambda}$ is indeed equivalent to increase the average optimism relative to the performances of the LETS. Similarly, smaller is α or greater the difference $(\alpha' - \alpha)$, higher is the number of workers interested in LETS. These two experiments test indeed the effect of an increased difference between the employability of short and long term unemployed people. It is not surprising that the LETS tend to me more attractive when it helps maintaining the employability of long term unemployed people. The effect of credit is more ambiguous: two effects are in this case in a trade-off relation. A smell amount of credit increases the average instantaneous revenue of LETSers. When the credit increases beyond some level, the negative effects on employability however dominates. The same relation will be observed above between credit and employment.

The number of workers that integrate the LETS does not determine always the effective composition of the LETS. It is the case only if workers are pessimistic concerning the performance of the LETS, especially the complement of revenue it permits. Once inside the LETS, workers can indeed observe the effective amount of benefice to apply, given in terms of instantaneous utility by:

$$A = b + a_u(b' - c) + a''C \tag{1.12}$$

when they are unemployed and

$$B = w + a_e(b' - c) + a''C \tag{1.13}$$

when they are employed. Similarly, wider is the LETS, more there exist opportunities to "produce", provide and accept services. Employability then increases all things equal with the population of the LETS. This property of the LETS is not expected by members. The equation (1.9) then takes its effective form (1.14) when the LETS is activated.

$$V_{ll} = (\alpha + \beta t^*(\alpha' - \alpha) - \gamma C^2)\frac{B + V_{el}}{1 + r} + (1 - (\alpha + \beta t^*(\alpha' - \alpha) - \gamma C^2))\frac{A + V_{ll}}{1 + r} \tag{1.14}$$

At this stage, its is possible to express both the dynamics of workers' subpopulations located at different positions in or outside the LETS. It is also possible to express the intertemporal expected utility of each of them. For instance, stationarity equation now write as:

$$qe_{nl} = \alpha' s + \alpha l \tag{1.15}$$

$$qe_{nl} = s \tag{1.16}$$

$$e_{nl} + l + s = (1 - t^*) \tag{1.17}$$

$$qe_l = \alpha' s_l + (\alpha + t^*(\alpha' - \alpha) - \gamma C^2) l_l \tag{1.18}$$

$$qe_l = s_l \tag{1.19}$$

$$t^* = e_l + s_l + l_l \tag{1.20}$$

where e_l, s_l and l_l figure respectively the proportion of employed, short term employed and long term employed workers in the LETS and e_{nl}, s_{nl} and l_{nl} the same populations outside the LETS.[2]

Equations (1.15) to (1.20) solve to provide the stationary populations occupying the six possible positions, inside and outside the LETS. Then, Bellman equations inside the LETS are provided by equation (1.14), associated to equations (1.21) and (1.22),

$$V_{el} = (1-q)\frac{B' + V_{el}}{1+r} + q\frac{A + V_{sl}}{1+r} \tag{1.21}$$

$$V_{sl} = \alpha'\frac{A' + V_{el}}{1+r} + (1-\alpha')\frac{A' + V_{ll}}{1+r} \tag{1.22}$$

When the effective level of utility V_{ll} calculated with equations (1.14), and (1.21)-(1.22), is greater or equal to the same level calculated from equations (1.7) and (1.11), all those who chose at a moment to integrate the LETS remain definitively members of the LETS. In the opposite case, the LETS reduces volume after a first excess of optimism relative to its performances. In this case, the LETS collapses since, having a full information about the performance of the LETS, workers are homogeneous inside the LETS as they were heterogeneous outside it, on the question of the performance of the LETS.

1.4 Results

At this stage, it is then possible to discuss the interest of the LETS from the point of view of employment and welfare. We begin by two properties of the LETS without

[2]All these population variables are obviously comprised between 0 and 1. When a negative value is obtained for one of these variables, this value is substituted by 0 and the result is then that the LETS does not emerge or conversely corresponds to the full economy

credit.

Proposition 2. *When the LETS emerges, remains active and distributes no credit, it increases employment.*

Proof: If the LETS has emerged and is active, the level of employment onside the LETS is given by e_l, solution of equations (1.15) to (1.19). It is easy to verify that, when $C = 0$, whatever t^*[3], the rate of employment inside the LETS e_l/t^* is higher that outside it $e_{nl}/(1 - t^*)$, this last being equivalent to the rate of employment e of the benchmark. As a consequence, wider is the LETS, higher is the global level of employment of the economy ■

This proposition is a simple consequence that, without credit, the LETS maintains the skills of unemployed workers and improves employability of long term unemployed workers. This proposition does not means that LETS always emerge when $C = 0$. Expectations could be too pessimistic to allow this emergence. As outside LETS, potential entrants tend to valuate more the advantages of credit than other benefits of the LETS, this emergence could even be restricted when $C = 0$.

To illustrate this proposition, we analyse graphically various cases for which $C = 0$ and the LETS emerges.

Let consider initial values:

$q = 0.2$; $\alpha = 0.5$; $\alpha^{'} = 0.75$; $w = 90$; $b = 50$; $b^{'} = 15$; $c = 5$; $\gamma = 0.0001$; $a^{'''} = 1.5$; $a^{''} = 0.1$; $r = 0.3$; $\bar{\lambda} = 3$; $\beta = 2$; $C = 10$.

We assume that $a_e = 0.5$ and $a_u = 1$, according to the difference of available time to produce in a LETS between unemployed and employed workers.

Levels of employment in the benchmark model and in the model with LETS are graphically illustrated. The abscissa axis figures the probability to lose a job, q,

[3]see the complete expression in appendix

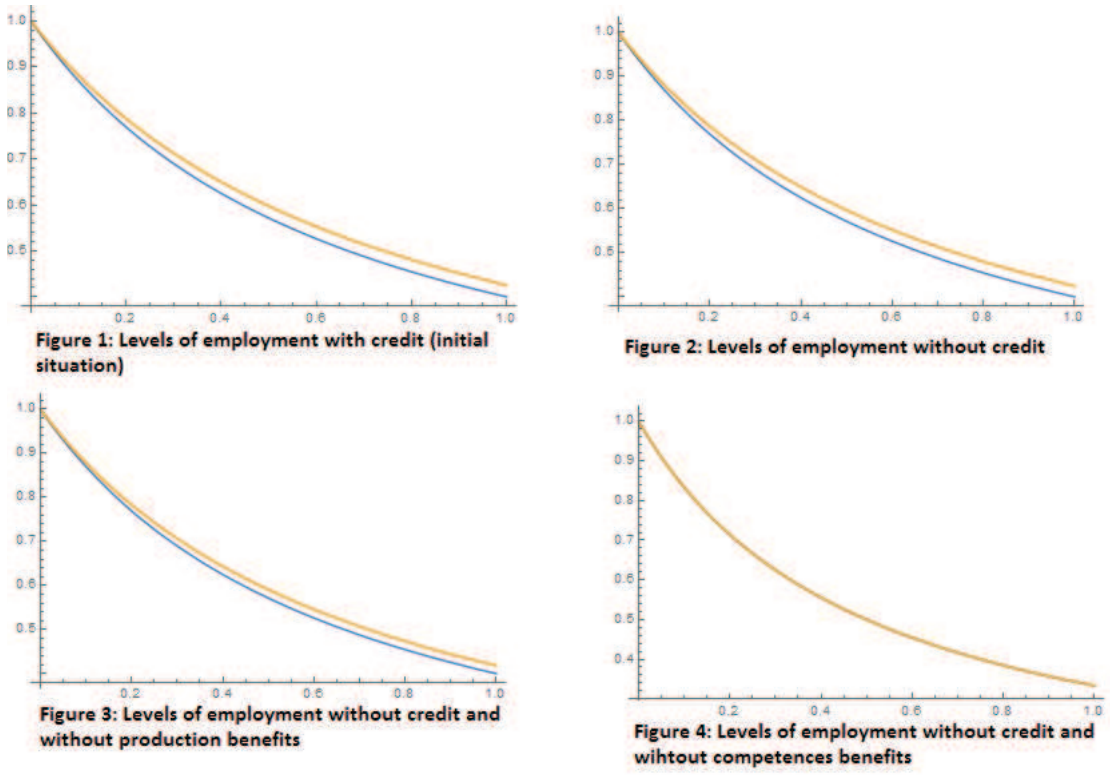

Figure 1.3: Comparison between levels of employment in the benchmark model and the model with a LETS without credit

and the ordinate axis the levels of employment. The level of employment of the benchmark model is plotted in blue and the level of employment with the LETS in yellow. The figure 1 (in figure (1.3)) represents the initial situation of a LETS providing a mutual credit: the level of employment is a decreasing function of q. The others figures represent various cases in which the LETS emerges without credit and improves the level of employment.

The second figure (in figure (1.3)) shows the comparison between levels of employment when there is no mutual credit distributed into the LETS, $a'' = 0$ and $\gamma = 0$, other things being equal. The level of employment in the LETS model is still higher than in the benchmark model and the LETS emerges because of the production and competence benefits remained equals, even if it has fewer members than in the initial situation. The third figure (in figure (1.3)) corresponds to the situation of a LETS without mutual credit and no production benefits, $a'' = 0$, $\gamma = 0$ and $b' = c$. The level of employment in the LETS model is still higher than in the benchmark

model and the LETS emerges because of the competence benefits remained equals. Finally, the situation without credit, $a^{''} = 0$ and $\gamma = 0$, and without competence benefits, $\alpha = \alpha^{'}$, is tested (figure 4 in figure (1.3)) and as expected, the two level of employment are the same in the LETS and benchmark models. The LETS still emerges because of the production benefits remained equals, but it doesn't enable anymore long-term unemployed workers to maintain their competences.

Proposition 3. *When the LETS emerges, remains active and includes no credit, it increases welfare.*

Proof: The comparison of welfare of the benchmark and the economy with LETS for $C = 0$ is made by considering expressions (1.12) to (1.14) and (1.21)-(1.22) for $C = 0$. As no one of the instantaneous payment nor the weight of the highest terms decrease in these equations, the value of V_{el}, V_{sl}, and V_{ll} cannot be smaller the respective values of V_e, V_s, and V_l in the benchmark. It follows that $t^*(e_l V_{el} + s_l V_{sl} + l_l V_{ll}) + (1 - t^*)(e_{nl} V_{el} + s_{nl} V_{sl} + l_{nl} V_{ll}) > eV_e + sV_s + lV_l$ ■

The spirit of this proposition is similar than this of the previous one. As LETS are profitable, in this case both because they provide an extra revenue (as small as it is) to members, and as they increase their chance to find a job, they increase the intertenporal utility of all positions inside the LETS but also the frequency of the position with the highest intertemporal utility (the position of employed workers inside the LETS). As a consequence, intertemporal utility is in average higher in the LETS than outside it and wider is the LETS higher is the welfare.

To illustrate this proposition, we analyze graphically various cases for which the LETS emerges even with $C = 0$. Initial parameters' values are keeping equals.

Levels of long-term unemployed workers' welfare in the benchmark model and in the model with LETS are graphically compared. The abscissa axis figures the probability to lose a job, q, and the ordinate axis the levels of welfare. The level of welfare in the benchmark model is plotted in blue and the level of welfare in the LETS model

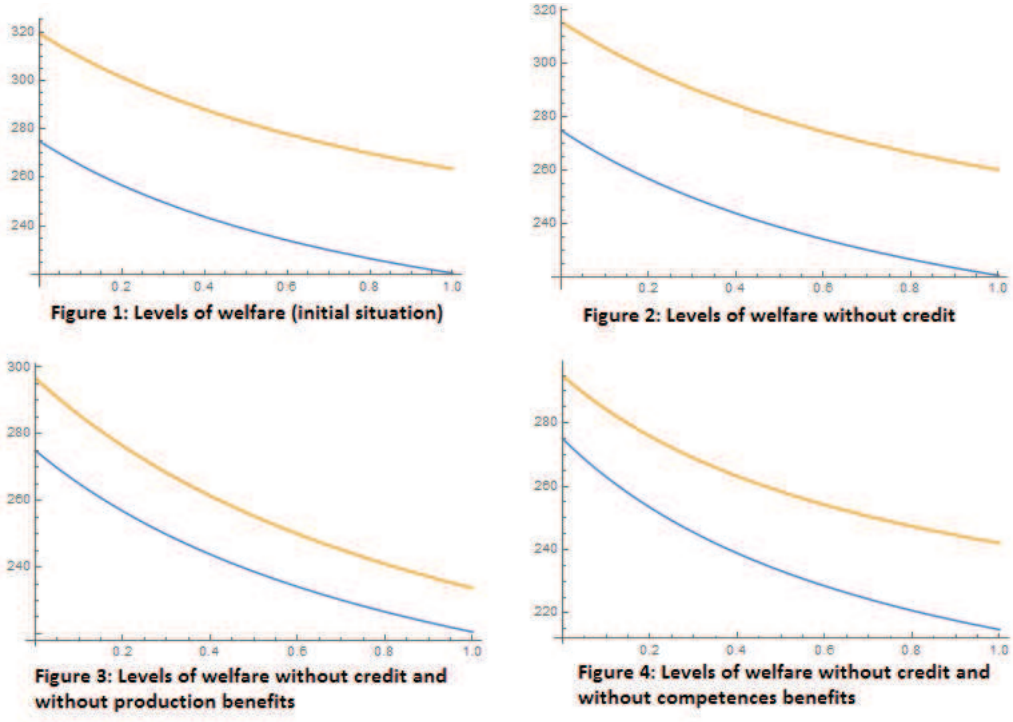

Figure 1.4: Comparison between levels of long-term unemployed workers' welfare in the benchmark model and the model with a LETS without credit

in yellow. The figure 1 (in figure (1.4)) represents the initial situation of a LETS providing a mutual credit and the level of welfare is a decreasing function of q. The others figures represent various cases in which the LETS emerges without credit and improves the level of welfare.

The second figure (in figure (1.4)) shows the comparison between levels of welfare when there is no mutual credit distributed into the LETS, $a^{''} = 0$ and $\gamma = 0$, other things being equal. The level of welfare in the LETS model is still higher than in the benchmark model and the LETS emerges because of the production and competence benefits remained equals, even if it has fewer members than in the initial situation. The third figure (in figure (1.4)) corresponds to the situation of a LETS without mutual credit and no production benefits, $a^{''} = 0$, $\gamma = 0$ and $b^{'} = c$. The level of welfare in the LETS model is less important than in the two previous situations because of the significant reduction of benefits provided by the LETS but it is still higher than in the benchmark model. The LETS emerges because of the competence benefits remained equals. Finally, the situation without credit, $a^{''} = 0$

and $\gamma = 0$, and without competence benefits, $\alpha = \alpha^{'}$, is tested (figure 4 in figure (1.4)). As well as in the previous situations, the LETS still improves the level of welfare by continuing to provide benefits for its members.

These two proposition have been studied with $C = 0$. However, one of our objective is also to study the role of the credit in the LETS. To tackle this issue, we begin by formulating the following lemmas:

Lemma 1. *The function $e_l(C)$ which at each level of credit C associates a level of employment in the LETS is continuous on the set of definition of populations variables*

Proof: The function $e_l(C)$ [4] is defined from 0 or $\underline{C}$ (the minimal amount of credit allowing the emergence of the LETS) according parameters and especially $\bar{\lambda}$. This expression is not continuous in $\mathbb{R}$ but it is around 0 or $\bar{C}$. Consider first two limit cases: (i) the case $\gamma = 0$, and (ii) the case $a'' = 0$. In the first case, all increase of C increases A, B, decreases λ^*, increases t^*, and finally e_l which increases more than e_{nl} decreases. This increase is continuous and monotonous until t^* makes the LETS attractive for the whole population (this observation reveals that this limit case is totally unrealistic since the performance of the LETS depend only on the amount of credit provided to members, as in a Ponzi game). In the second case, all increase of C bas a negative impact on expression (1.9), tends to increase λ^* and to decrease t^*. In this case, all increase of C decreases e_l more than it increases e_l and the function $e_l(C)$ is strictly decreasing. This decrease is continuous and monotonous until the value of C which empties the LETS. The general case is in between these two extreme cases. Note that as soon as $\gamma > 0$, the negative impact of the credit always ends up to dominate the positive one when C increases. The result is that even with a very small value of γ, it is possible to empty the LETS only by a sufficient increase of the average credit available for each member ■

Lemma 2. *The functions $V_{el}(C)$, $V_{sl}(C)$, $V_{ll}(C)$ which at each level of credit C*

[4] see full expression in appendix

associate a level of expected utility of employed, short term and long term unemployed workers in the LETS are continuous on the set of definition of populations variables

Proof: Expressions (1.12) to (1.14) and (1.21)-(1.22) determine the equilibrium values of $V_{el}(C)$, $V_{sl}(C)$, and $V_{ll}(C)$ inside the LETS. They depend directly on C via the place of C in instantaneous utilities and expression (1.14), and indirectly, via t^*. The system is continuous in each term and t^* continuous on C in relevant subsets of variation of population variables. All expressions are finally continuous ■

Proposition 4. *When $\bar{\lambda} > \frac{c}{b'}$, there always exist a level of credit C^* which maximizes the rate of employment of the economy.*

Proof: Whatever the value of t^*, the average amount of credit obtained by LETS members has only two effects on entry conditions. It increases the expected instantaneous utilities (1.7) and (1.8) and decreases the weight of the first term of expression (1.9). The resulting effects on intertemporal utilities, then on λ^* and t^* are then ambiguous. Suppose however that $\bar{\lambda} > \frac{c}{b'}$. Then for $C = 0$, only remains one difference between the benchmark Bellman equations and the entry Bellman system (1.9) to (1.11). This difference is caused by the term $(\lambda_i b' - c)$ in A and B. With $\bar{\lambda} > \frac{c}{b'}$, there always exist a subset of adopters (those with the highest values of (λ_i)) which decide to join the LETS. In this case, still for $C = 0$, one verifies that $t^* > 0$ and that in the final Bellman equations the condition $(b' > c)$ is sufficient to confirm the choice of those who decided to integrate the LETS. From stationarity equations (1.15) to (1.20) we then easily deduce that the new rate of employment $e_{nl} + e_l$ is greater than the benchmark one e still for $C = 0$. Given lemma (1), one conclude that if $e^*(C)$ decreases with C close to $C = 0$, the optimal amount of credit is $C = 0$ while it the optimal amount is such that $C > 0$ if the function $e^*(C)$ increases in the same neighborhood ■

The relevant observation is that it is not always optimal to minimize the volume of credit to enhance employment. As entry in the LETS is the first objective, credit must be sufficient to allow the LETS emergence.

Proposition 5. *The amount of credit C^w which maximizes welfare is usually higher than the level C^* that maximizes the level of employment.*

Proof: From the point of view of employment, the only motive to maintain a positive level of credit C is that when $\bar{\lambda}$ is too low, it is necessary to stimulate workers to participate y the announce of a sufficiently high average level of micro-credit. With small values of γ, increasing credit from the level optimal from the level maximizing employment could be welfare improving, as soon as the positive effect of credit on consumption is not dominated by its bad effect on employment ■

To illustrate this proposition, we plot on the same figure, the level of employment and the level of long-term employed workers' welfare, in order to identify the level of credit maximizing these two functions. The abscissa axis figures the average level of credit by LETS member C. The first figure (figure (1.5)) corresponds to the initial situation with the initial parameters' values, exposed previously. The level of employment is plotted in blue, and the level of welfare is plotted in purple. In the initial situation (figure (1.5)), the maximum level of credit maximising the employment level, reached for approximately 10 units of credits, is lower than the maximum level of credit maximizing the welfare level reached for approximately 50 units of credits.

Now, let consider different measures of parameters in order to evaluate if the maximum level of credit maximizing the employment level is always higher than the maximum level of credit maximizing the welfare level (figure (1.6)).

Firstly, we study the impact of movements of the probability to lose a job, q. We analyze two situations: q is decreased or increased according to the initial situation, other things being equals.

In these situation, q is firstly decreased to 0.1, then increased to 0.6, other things being equals. The level of employment in the second situation is significantly lower

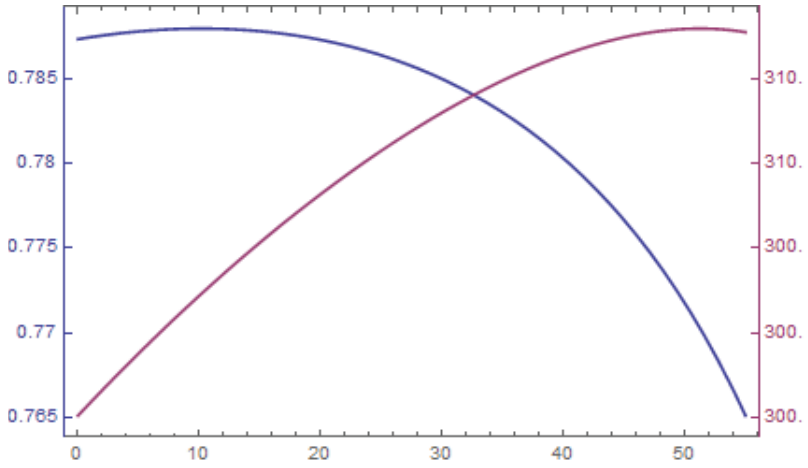

Figure 1.5: Comparison between levels of long-term unemployed workers' welfare and the level of employment in the LETS model

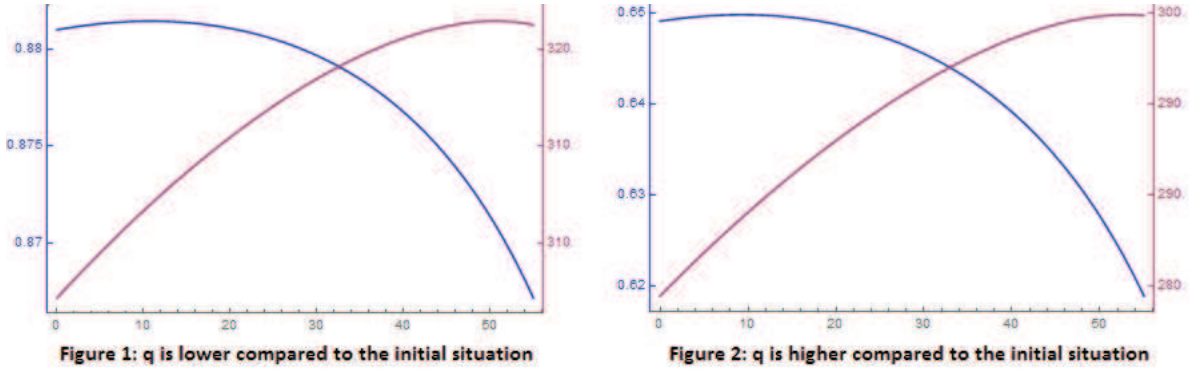

Figure 1.6: Comparison between levels of long-term unemployed workers' welfare and the level of employment in the LETS model

than in the first one. In the first situation, the level of credit maximizing the level of employment is lower than in the second one. In fact, more important is the probability to lose a job, more the need to maintain competences during unemployment spells is high. According to the ambiguous role of credit in maintaining competences, too much credit can discourage LETS members to produce, which doesn't enable the competences improvement. On the contrary, the level of credit maximizing the level of welfare is higher in the second situation. In fact, to compensate the negative role of the rise of the probability to lose a job on welfare, the level of credit need to be more important.

We then study the impact of movements of the difference $(\alpha' - \alpha)$ (figure (1.7)).

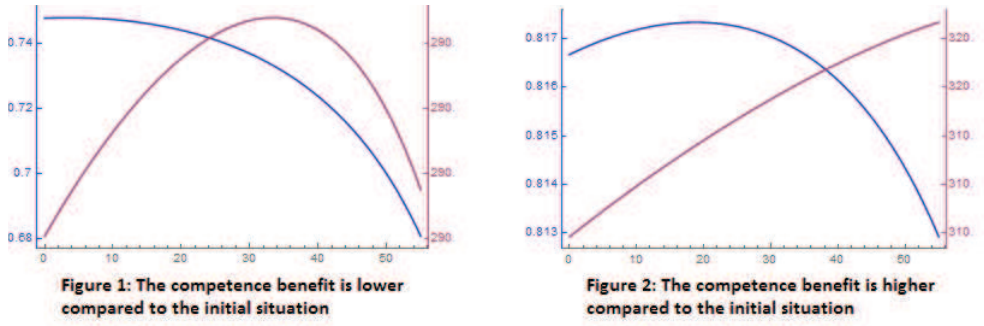

Figure 1.7: Comparison between levels of long-term unemployed workers' welfare and the level of employment in the LETS model

We also analyze two situations: the competence benefit is decreased or increased according to the initial situation, all things equals. In the first situation, $\alpha^{'} = 0,6$ and $\alpha = 0,5$, $(\alpha^{'} - \alpha)$ is now equal to 0.1 (0.25 in the initial situation). In the first situation, $\alpha^{'} = 0.9$ and $\alpha = 0.5$, $(\alpha^{'} - \alpha)$ is now equal to 0.4.

The level of employment in the first situation is significantly lower than in the second one, the competence benefit provided by the LETS being lower. In the first situation, the level of credit maximizing the level of employment is lower than in the second one. In fact, less important is the competence benefit form the LETS, more the need to produce is important. By the same mechanisms, the level of credit maximizing the level of welfare in the first situation is lower than in the second one.

Thirdly, we study the impact of movements of the efficiency of the LETS relative to its size, β (figure (1.8)). Two situations are analyzed: the efficiency is decreased or increased according to the initial situation, other things being equals. In the first situation, $\beta = 1$ and in the second one $\beta = 3$ (compared to $\beta = 2$ in the initial situation).

Movements of β impact only the level of credit maximizing the long-term unemployed workers' welfare, since it is not included in the level of employment calculation. If the efficiency of the LETS, relative to its size, is lower, then the level of credit maximizing the level of welfare is also lower. If the LETS is less efficient, members will need to produce more to insure their competences improvements, in

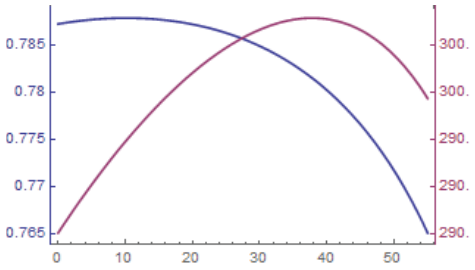

Figure 1: The efficiency of the LETS is lower compared to the initial situation

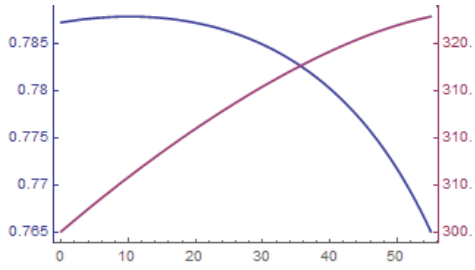

Figure 2: The efficiency of the LETS is higher compared to the initial situation

Figure 1.8: Comparison between levels of long-term unemployed workers' welfare and the level of employment in the LETS model

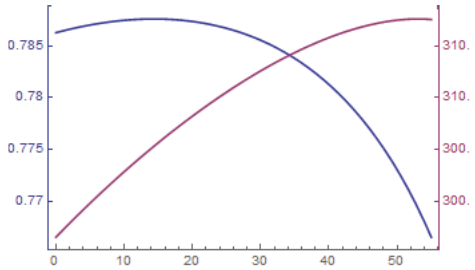

Figure 1: The size of the LETS is lower compared to the initial situation

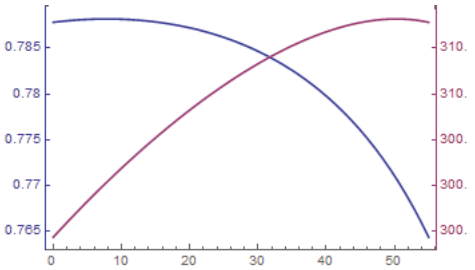

Figure 2: The size of the LETS is higher compared to the initial situation

Figure 1.9: Comparison between levels of long-term unemployed workers' welfare and the level of employment in the LETS model

adequacy with a relatively low level of credit.

Finally, we study the size of the LETS, by studying $\bar{\lambda}$ (figure(1.9)). Two situations are analyzed: the size of the LETS is decreased (which means that $\bar{\lambda}$ is decreased) or increased according to the initial situation, other things being equals. $\bar{\lambda}$ is firstly decreased from 3 to 2 and secondly increased to 4.

The size of the LETS has a negative impact on the levels of credit maximizing both the level of employment and the level of welfare. In fact, mutual credit facilitates exchanges by enabling members to buy before selling. Credit is useful because when members don't find partners to buy their products and services, and need a sufficient amount of complementary currency to buy themselves. If the size of the LETS is increased, members are assured to find other members to sell their production. Then, their necessity of having access to credit is reduced.

Proposition 6. *When the LETS is active, if a regulator tries to determine the rate of credit able to increase the level of employment of the economy, he/she will never tolerate a larger amount of credit by member than permitted during the emergence of the LETS.*

Proof: If the LETS is active for a given level of credit $\bar{C}$, two conditions are validated: (i) $t^* > 0$ given $\bar{\lambda}$; (ii) C is such that the LETS does not collapse after having emerged, *i.e.* V_{ll} expressed from equations (1.12) to (1.14) and (1.21)-(1.22) is greater than V_l solution of the benchmark corresponding to equations (1.4) to (1.6). From these properties, two casezs are then possible. If the expression of V_{ll} associated to expressions (1.12) to (1.14) and (1.21)-(1.22) has a portion increasing with C from $C = 0$ to $C = \bar{C}$, a decrease of the level of credit increases e_l obtained from the solution of stationary equations (1.18) to (1.20). The maximal rate of employment inside the LETS is consequently obtained for the level of credit C^* which makes equivalent for LETS members to remain in the LETS or to leave it. If the expression of V_{ll} associated to equations (1.12) to (1.14) and (1.21)-(1.22) always decreases with C from $C = 0$ to $C = \bar{C}$, the maximal rate of employment inside the LETS is conversely obtained when $C = 0$. On both cases, there is then a possible regulation of the average level of credit by member which maximizes employment inside the LETS ■

Proposition 6 is a consequence of the differentiate effects of credit on entry, individual utility inside the LETS, and employability. Consider for instance a relatively small value of γ and a relatively high value of a''. Then, if $\bar{\lambda}$ is not too small, a relatively high amount of credit not only facilitates the emergence of the LETS and determines a positive value of t^*, but also enhances the utility of LETS members once in the LETS. With this credit LETS members - especially unemployed ones - can buy even if they have not produced or/and sold: as a consequence, this credit reduces employability and effective employment e_l inside the LETS from stationary equations. If an hypothetical "LETS regulator" acting as a planer is tries to improve employment, the appropriate policy should be to maintain in this case a sufficiently

appreciable amount of credit in the LETS as soon as all potential members have not integrated it. Then, once the LETS is stabilized in a position of "excess pessimism" of entrants (i.e. with members rather satisfied of the effective performances of the LETS), the relevant action of the "LETS regulator" is to reduce the amount of credit C in order to improve employment, without compromising the choices of entry of members.

1.5 Concluding remarks

This chapter analyzes the global effects of a social mobile complementary currency circulation between employed and unemployed workers into a community. We estimate that participating on a social currency system enables long-term unemployed workers to maintain their skills, avoiding human capital depreciation occurring during unemployment spell, and to preserve and extend their social network. These benefits have a positive effects on unemployed workers employability and enable them to re-enter the job market more quickly. We first introduce a benchmark Pissarides-style model with two possible positions for unemployed workers: short term unemployed workers have a higher instantaneous probability to find a job than long term ones. We then introduce LETS having two properties: (i) to improve, thanks to the complementary currency and the mutual credit, the potentiality to exchange goods and services in the informal sector, and (ii) to maintain professional skills outside job. We find that trust in the complementary currency outside LETS and the level of mutual credit are crucial to make LETS permanent (to avoid LETS collapse). However, if the level of credit has to be sufficient to initiate exchanges between members, and enables LETS to emerge, this level shall not be too important to still encourage members' production, a key element in maintaining their competences and in improving their employability. Moreover, the amount of credit maximising the level welfare is always higher than the amount maximising the level of employment. In fact, the amount of credit maximising employment can't be too important in order to encourage LETS members to produce. However, the credit is also a mean for LETS members to exchange in an informal way and to rise their

purchasing power. That is why the amount of credit maximising the level welfare is always higher than for the employment level. This result arises the issue of LETS objectives. The amount of credit distributed to the members will not be the same according to the goals promoted by the introduction of a LETS. Finally, when LETS are permanent, we find that they increase employment, the level of expected utility of employed workers, and are Pareto-improving when compared to the benchmark case without LETS.

Another fact is important to highlight in order to explain the rise of employment in an economy with LETS. In fact, more than improving employability of members, LETS is also a mean to develop a self-employment activity. Surveys conducted in LETS in UK and in Argentina concluded that LETS encourage the development of self-employment (Williams et al., 2001; Gomez and Helmsing, 2008). Developing an activity into a LETS provides advantages to members, as developing a client base which will continue to buy those products outside the LETS (Williams et al., 2001), testing products to evaluate if they are valuable on the formal market (Williams et al., 2001), and a self-training for the development of a micro-entreprise (Gomez and Helmsing, 2008). These elements facilitate the creation of a micro-entreprise for LETS members. In the survey conducted by Williams et al. (2001), of 810 LETS members respondents, 10.7% explain that "their LETS had helped them become self-employed". And, in the survey conducted by Gomez and Helmsing (2008), in Clubs de Trueque in Argentina, 78 of 140 respondents tested their activity in the regular economy, of which 40 respondents were still active after one year.

Chapter 2

Mobile Money: Financial Inclusion in emerging and developing countries

2.1 Introduction

Mobile Money is designed to offer unbanked people an access to financial services, especially in emerging and developing countries still lacking in banking infrastructures and accessibility, with a view to achieving Financial Inclusion of financial excluded (We talk about Mobile Money for Unbanked people ("MMU")).

Mobile Money is based on simple financial services at the disposal of customers. It offers them electronic accounts on which they can deposit cash up to a certain celling and from which they can withdraw cash and manage their electronic money. Access to these accounts and associated services is easy: a national identification card only is required to register with the service, and the opening, crediting and managing of accounts are free of charge. Only money exchanges are subject to a tax. Mobile Money services allow the subscribers to send/receive money to/from subscribers of the same service or banked customers (including domestic transfers, international remittances, bills payment). Moreover, users can build on a growing network of agents, consisting in service providers' employees and retail trade partners.

Business models and service providers of Mobile Money are numerous (bank-led, non bank-led, cooperation), but the non-bank led model remains the most common one in place and these services are often called “branchless solution” (Lyman et al., 2006; Mas, 2009). Today, 70% of existing Mobile Money services have been launched and are managed by Mobile Network Operators (MNO) (Pénicaud, 2012). However, banks are not totally excluded from these new services, and often, private service providers of Mobile Money cooperate with them, especially in order to extend the range of financial services offered.

The present chapter deals with Mobile Money services provided by non-banking private actors, a ”branchless solution”, to evaluate the effective ppotential of this alternative financial solution. Mobile Money literature is still dominated by practitioner research and case studies results (Mas, 2009; Morawczynski and Pickens, 2009; Camner and Sjöblom, 2009; Heyer and Mas, 2009; McKay and Pickens, 2010; Camner et al., 2010; Mas and Radcliffe, 2010; Merritt, 2011; Jack and Suri, 2011; Bosire, 2012; Di Castri, 2013; Di Castri and Gidvani, 2014). This chapter proposes a larger macroeconomic analysis of the determining factors leading to the implementation and adoption of Mobile Money services in emerging and developping countries. As the issue at stake here is the inclusion of those with limited or no access to banking services, the focus is on the Financial Inclusion factors (as defined by Sarma and Peis, 2011), with an analysis of what characterizes the countries implementing Mobile Money and where this service is most successful. The first issue is to determine whether the service providers’ interests match with Mobile Money objectives, namely the Financial Inclusion of financially excluded people, thus fulfilling a clearly identified social need. The determinants of MMU implementation are studied to assess whether Mobile Money services are launched in countries where banking access is most lacking, in accordance with its main goal. A macroeconomic analysis, using a Mundlak (1978) correction probit model is conducted on 83 emerging and developing countries between 2004 and 2012, a period in the course of which Mobile Money services emerged and developed most. The second issue is realised to understand

determinants of Mobile Money adoption by establishing the profile of countries in which MMU is a success and those in which MMU doesn't succeed to reach potential adopters. Adequacy between necessary conditions of implementation, supply side requirements, and demand needs and specificties, demand side characteristics, is analysed to understand if Mobile Money is a relevant instrument to fight financial exclusion. A statistical study is conducted on 35 countries having at least one bank-led or non bank-led Mobile Money service in 2011. Then, a clustering analysis is run on 25 countries benefiting from a non-bank led MMU to understand factors influencing the Mobile Money alternative adoption and to evaluate adequacy between these factors and MMU supported goals.

2.2 MMU, a Financial Inclusion answer to Banking Exclusion

To understand goals of Mobile Money services, it is crucial to define the situation of Financial Inclusion, and subsequently the situations of financial exclusion. Indeed this definition is not the same from the Financial Inclusion literature point of view (Toxopeus and Lensink, 2007; Beck et al., 2008; Sarma, 2008, 2012; Ramji, 2009; Sarma and Peis, 2011; Demirguc-Kunt and Klapper, 2012; Allen et al., 2013, 2014) and from the Mobile Money literature (Morawczynski and Pickens, 2009; Camner and Sjöblom, 2009; Mbiti and Weil, 2011; Jack and Suri, 2011).

2.2.1 Financial Exclusion expressed as Banking Exclusion

In Financial Inclusion literature (Toxopeus and Lensink, 2007; Beck et al., 2008; Sarma, 2008, 2012; Ramji, 2009; Sarma and Peis, 2011; Demirguc-Kunt and Klapper, 2012: Allen et al., 2013, 2014), this concept is associated with banking. Some studies describe Financial Inclusion as the simple fact of having a bank account (Toxopeus and Lensink, 2007; Ramji, 2009). It can also be expressed as the fre-

quency of use of banking services, such as the fact of effectively using a bank account and the number of common operations done via a bank account (Allen et al., 2013). The most complete definitions of Financial Inclusion include banking factors of accessibility to banking services (having a bank account), availability of banking infrastructures (number of Automated Teller Machines (ATM) and bank branches per sq km or per people) and the effective use of banking services (level of deposits and credits) (Beck et al., 2008; Sarma, 2008, 2012; Sarma and Peis, 2011; Demirguc-Kunt and Klapper, 2012; Amidzic et al., 2014). Sarma and Peis (2011) proposed an Index of Financial Inclusion (IFI) the calculation of which is composed of these three banking factors (accessibility, availability, and usage) and provides an index between 0 and 1. IFI is calculated on the aggregation of these three factors to build a complete measure of Financial Inclusion in a country with a view to ranking different countries. Each dimension is expressed as follows:

$$d_i = w_i \frac{A_i - m_i}{M_i - m_i}$$

where d_i is the index of the dimension i, w_i is the weight related to the dimension between 0 and 1, A_i is the actual value of the variable(s) used to calculate the dimension for the i_{th} country, m_i is the lower limit on the value of the variable(s) used to calculate the dimension, and M_i is the upper limit on the value of the variable(s) used to calculate the dimension. w_i expresses the relative importance of the dimension i in the IFI.

These three dimensions are then computed to perform the IFI:

$$IFI = 1 - \frac{\sqrt{(w_1 - d_1)^2 + (w_2 - d_2)^2 + \cdots + (w_n - d_n)^2}}{\sqrt{w_1^2 + w_2^2 + \cdots + w_1^2}}$$

According to Financial Inclusion literature, Financial Inclusion is equivalent to banking inclusion. Financial exclusion, or more precisely banking exclusion, results from many factors preventing people from accessing to bank services. The main reason is the lack of availability of banking infrastructures and services (Findscope, 2009; Camner and Sjöblom, 2009; Mbogo, 2010; Jack and Suri, 2011; Mbiti and Weil,

2011; Demirguc-Kunt and Klapper, 2012; Alexandre and Eisenhart, 2013; Allen et al., 2013). The difficulty of accessing and using banking services is mainly a physical one. The low territorial coverage of banking infrastructures leaves many people behind, especially those living in rural areas (Beck et al., 2008, 2010; Sarma, 2008, 2012; Sarma and Peis, 2011; Demirguc-Kunt and Klapper, 2012). Proximity to banking equipments and infrastructures is crucial to enhance Financial Inclusion (Allen et al., 2013). Bank services charges are also a key point in Financial Exclusion. High fixed and transaction costs discourage people from entering the banking system (Beck et al., 2008; Allen et al., 2013). Finally, a lack of knowledge about financial services, named Financial Literacy (Findscope, 2009; Camner and Sjöblom, 2009) can also be a factor of Banking Exclusion. Financial Literacy is closely related to factors such as literacy, level of education, numeracy skills and access to information (Findscope, 2009).

2.2.2 Mobile Money : promoting wider Financial Inclusion in order to fight Banking Exclusion

Mobile Money is promoted as a tool against financial exclusion, because it addresses two of major issues, if not more. On the one hand, it offers financial services at a lower cost than banks do (Morawczynski and Pickens, 2009; Mbiti and Weil, 2011; Donovan, 2012; Venet and Arestoff, 2013). Opening and crediting a Mobile Money account or keeping it open can be done at no cost; account management is free of charge and low fees are charged for day-to-day financial needs such as withdrawals and transfers (see tariffs of Mobile Money services on providers website). In a survey realised on 18 branchless banking providers in 10 different countries, McKay and Pickens (2010) estimate the price of branchless banking solutions at an average of 19% lower than bank fees. On the other hand, Mobile Money providers deploy a growing network of agents in order to offset the shortage of banking infrastructures and to make financial services available (Morawczynski and Pickens, 2009; Camner and Sjöblom, 2009; Mbiti and Weil, 2011; Jack and Suri, 201). These agents include

both service providers' employees and retail stores (cash-in / cash-out points) offering users the possibility to deposit and withdraw cash. In 2012, a survey realised by the Groupe Speciale Mobile Association (GSMA) on the state of Mobile Money Industry estimates that in 28 countries, Mobile Money agents were more numerous than bank branches. This is true for Tanzania where 17541 Mobile Money agents are deployed in the country compared with only 504 bank branches (Di Castri and Gidvani, 2014).

In Mobile Money literature, the concept of Financial Inclusion is disconnected from banking (McKay and Pickens, 2010; Di Castri, 2013; Mas, 2009; Morawczynski and Pickens, 2009; Camner and Sjöblom, 2009; Heyer and Mas, 2009; Camner et al., 2010; Mas and Radcliffe, 2010; Merritt, 2011; Jack and Suri, 2011; Bosire, 2012). Mobile Money is designed to provide a financial connection between consumers (Lawack, 2013), and this solution is named the "Branchless banking" one (Lyman et al., 2006; Mas, 2009), a concept that refers to financial services offered by private or financial actors which are not banks (Dermish et al., 2011). However, banks are not totally excluded from this Financial Inclusion provided by Mobile Money. Banks are essential to Mobile Money service providers because they enable them to manage their liquidity. That is why Alexandre and Eisenhart (2013) described these services as "banking beyond branches" solution. Moreover, Mobile Money service providers can propose a product in cooperation with banks, especially to widen the range of financial services. Recent studies take the development of Mobile Money systems into account and integrate this new possibility into their definition of Financial Inclusion (Allen et al., 2013).

2.3 Mobile Money services' implementation and adoption determinants

As stated above, Financial Inclusion is a crucial point in the service providers decision to implement Mobile Money services in a country. However, other socio-

economic determinants are taking into account in their decision, to ensure a right deployment and a sufficient adoption of their services.

2.3.1 Financial Inclusion, does it encourage or discourage Mobile Money implementation and adoption?

According to Mobile Money literature, Financial Inclusion and banking system development nationwide greatly influence the service providers' decision to setup a Mobile Money service. Indeed, Financial Inclusion being a key factor in Mobile Money adoption, it influences to a large extent MMU service providers' decision to implement this system (Mas and Morawczynski, 2009; Camner and Sjöblom, 2009; Camner et al., 2010; Mas and Radcliffe, 2010; Heyer and Mas, 2009; Merritt, 2011; Bosire, 2012). But, Financial Inclusion can both encourage and discourage Mobile Money adoption users and, thereby, service providers' decision to launch their financial activity. An inclusive banking system, in terms of accessibility, availability and use, may be difficult to compete. If people have an easy access to banking system, there is no need for another financial system to replace it (Heyer and Mas, 2009; Bosire, 2012). Mobile Money, as a service offering easy and low-cost access to financial services would be both pointless and unused.

On the other hand, from the point of view of pratical implementation, service providers need an effective banking system to launch and sustain their activity. They must have access to financial facilities in order to launch a Mobile Money. Similarly, agents, as local representatives assuring connection with the users, must have an easy access to banking infrastructures, which constitutes one of the Financial Inclusion factors (availability). Agents are either service providers' employees or retail outlet keepers. They are in charge of the opening and crediting of users' electronic accounts with the amount the users have given them in cash. So they need to be in the vicinity of bank branches or ATM to manage their liquidity (i.e. deposit users' cash on their own account and withdraw funds in order to provide enough cash to customers) (Mas and Morawczynski, 2009; Camner and Sjöblom,

2009; Camner et al., 2010; Mas and Radcliffe, 2010; Merritt, 2011; Bosire, 2012). Finally, an inclusive banking system is synonymous with financial experience. If a population can relatively easily integrate the banking system, it benefits from a financial experience which makes it more inclined to adopt a financial service. Financial experience is a real advantage for Mobile Money service providers who know they will meet the users' demand in offering new financial services (Camner et al., 2010). This idea is also supported by literature dealing with innovation adoption, developed in the next sub-part.

2.3.2 A national environment enabling Mobile Money adoption and implementation

If Financial Inclusion is the key point in implementation decision and adoption of Mobile Money services, it is not the only one. Other macroeconomic factors, domestic enabling factors, impact adoption and service providers' decision. These determinants are described in Mobile Money literature, but they refer to traditional factors identified in industrial location and in literature on innovation's adoption. Indeed, Mobile Money service providers analyse business and social-demographic environment of the country they want to enter or in which they want to implement a new Mobile Money service, in order to predict the number of their potential customers (adoption) and the potential frequency of use of their new services (diffusion).

First of all, Mobile Money service providers need to meet a large population, an extensive potential customer base. They offer financial services at low-cost, so to ensure their profitability they need to be sure that a large number of customers will adopt their services (Heyer and Mas, 2009). The market size is a traditional factor in the choice of industrial location (Davidson, 1980; Krugman, 1990, Wheeler and Moody, 1992). Market size is commonly estimated by the standard of living of the country's inhabitants, measured by the GDP per inhabitant. A firm setting up in a country needs to be sure that the sales level will cover the cost of produc-

tion, which means that the inhabitants' purchasing power is sufficient for them to adopt its product. As seen previously, Mobile Money is a low-cost financial service intented for low income customers. So, GDP per inhabitant is not relevant to measure market size in Mobile Money implementation case. The market size can be approximated through the mobile phone penetration rate in the country. This rate shows the proportion of the population for which Mobile Money is accessible and potentially adoptable. In fact, the customer base of a Mobile Money providers must have either a mobile phone or access to a mobile phone in order to use its services. Mobile phone penetration in a country of implementation is a crucial point that service providers examine in depth before their installation (Camner et al., 2010; Heyer and Mas, 2009; Bosire, 2012). Market size can also be related to the positive network effects of Mobile Money adoption, as described in "search-theoretic" approach to monetary economics and in the literature on financial and monetary innovation adoption. In fact, the adoption of a new money or a new means of payment depends on the number of customers using it, thus making it attractive through the multiplication of possible exchanges. The utility of a certain means of payment (or money) increases with the number of its users (Kiyotaki and Wright, 1993; Katz and Shapiro, 1994; Berentsen, 1998; Shapiro and Varian, 2000; Rysman, 2004; Chou et al., 2004; Orléan, 2008). Finally, the launching of a Mobile Money in a country requires a regulatory environment supporting such initiatives. At the national level, Central Banks initiate regulations and provide licences for Mobile Money service providers who want to launch a new system. Licences allow service providers to propose a certain range of financial services. Generally they cannot compete with a bank and cannot commercialise all traditional financial services. Central Banks allow non-bank service providers to offer financial services on a case-by-case basis (Bosire, 2012; Di Castri, 2013). National business policies are determining factors in industry location. Indeed, firms are more likely to locate their activities in countries having pro-business policies (Holmes, 1998), including fiscal incentives (Hines, 1999; Devereux and Griffith, 2002), low corporate income taxes (Devreux and Griffith, 1998), institutional quality, in particular as regards the control of corruption, the level of property rights (Disdier and Mayer, 2004), and the political risk (Wheeler

and Mody, 1992). All these indicators of national institutional quality and pro-business policies are included in the "Regulatory Quality" Index (Kaufmann et al., 2005).

Before locating their Mobile Money service in emerging and developing countries, Mobile Money service providers must make be sure that such a service will be adopted by their inhabitants. Mobile Money service providers have to ensure the assimilation of their services more than adoption, i.e. the real use (Fichman and Kemerer, 1993; Agarwal and Prasad, 1997). Indeed, adoption of Mobile Money could be measured by the number of account openings and assimilation by the number of transactions realised by users. Opening a Mobile Money account is free and doesn't generate profits for the service provider. Transaction fees represent its unique source of income.

Adoption, and more precisely assimilation, of an innovation is largely studied in economic literature. Several theories have been developed in order to understand and predict the adoption of an innovation: the Technology Acceptance Model - TAM - (Davis et al., 1989; Davis, 1989, 1993), the Theory of Planned Behaviour - TPB - (Ajzen, 1985, 1991), the Innovation Diffusion Theory (Rogers, 1983). These models analyse the innovation's characteristics and the benefits they provide the users, with a view to predicting the potential adoption of such an innovation. On the basis of these models, it is possible to detect macroeconomic factors which can affect the decision of implementation of Mobile Money service in a specific country by evaluating the real interest of the service, thus predicting its potential adoption.

Rogers (1993) proposes the Innovation Diffusion Theory in which he distinguishes six perceived interests that an innovation must involve for the users to adopt and assimilate it: relative advantage, complexity, compatibility, image, observability and trialability. Mobile Money offers a relative advantage to customers by providing cheaper financial services than existing banking system. McKay and Pickens (2010) reveals in a survey that using Mobile Money is about 19% cheaper on average than

using banking system. On the other hand, Mobile Money financial services are accessible from users' mobile phone. To realise transactions, deposits, or withdrawals, no banking infrastructure is required (ATMs or bank branches, often poorly distributed in countries suffering of Financial Exclusion). The large diffusion of mobile phone technology in emerging and developing countries facilitates Mobile Money usage, often a SMS-based service. It offers the inhabitants of these countries uncomplicated financial services. In addition, Mobile Money is compatible with existing needs in emerging and developing countries where domestic transfers, provided by Mobile Money, are mainly performed between urban and rural areas. Rural inhabitants move into the city to find a job in order to feed their family remaining in rural areas. They then send money to their family and Mobile Money enables these transfers. The rate of urbanisation, combined with the rate of labour force participation, expresses these movements of population from rural to urban areas and the corresponding need for Mobile Money services (Medhi et al., 2009; Camner et al., 2010; Bosire, 2012; Buku and Meredith, 2013). Besides, the innovation to be adopted must be compatible with past experiences. This compatibility can be related to the need for financial knowledge and experience (Financial Literacy) essential to ensure adoption of Mobile Money, which is itself correlated to literacy, level of education, numeracy skills and access to information (Findscope, 2009). The need for Financial Literacy can also be linked up with the perceived trialability of the innovation. Indeed, potential users must perceive that they have an opportunity to experiment with the innovation prior to use it. Financial Literacy, and more precisely financial experience, appears to be primordial to Mobile Money adoption, as a kind of trial of this new service.

Finally, regarding innovation adoption, Ajzen (1985, 1991) mentions the perceived behavioural control as an element to be taken into account among those determining the attitude towards usage intention. In fact, potential users can face internal and external factors which act as major constraints on behaviour, called the "volitional control factors". A lack of individual abilities and skills to use the innovation can disturb the relation between the intentional behaviour and the effective behaviour. In

addition, the potential users' perceived self-efficacy (Taylor and Todd, 1995; Khraim et al., 2011), i.e. the potential users' perception of and self-confidence in their ability to use the innovation can also represent a limiting factor for adoption and usage. The volitional control factors and the self-efficacy perception depend on the level of education of a population. It can be approximated using the enrolment ratio in secondary education. Targeted country's population must be literate because most of Mobile Money services are SMS-based (M-PESA) or work via an electronic platform (MTN Mobile Money). People have then to know how to read and write in order to use these systems (Camner et al., 2010; Merritt, 2011; Buku and Meredith, 2013), because it corresponds to the effective abilities and skills needed to adopt and use the innovation. The enrolment ratio in secondary education indicates the ratio of children who have completed the primary programme in which writing and reading skills are taught. Individuals also need to have a high level of education in order to attain the self-efficacy necessary to adoption. Education also plays an important role in agents enrolment. In fact, some practitioners insist on the importance to recruit educated agents to ensure their "ability to make appropriate decisions" (Flaming et al., 2011).

The issue of this section is to determine if Mobile Money services are launched in countries where banking access is most lacking, in accordance with their objective. A macroeconomic analysis of domestic environment factors enabling Mobile Money implementation, as previously mentioned, is conducted with the help of a Mundlak (1978) correction probit model on 83 emerging and developing countries between 2004 and 2012.

2.4 Mobile Money Implementation Model: Method and Data

To study impact of Financial Inclusion on the service providers to implement a Mobile Money in a country, and understand the effective potential of this innovative

solution as an inclusive financial alternative, a Mundlak (1978) correction probit model is run.

2.4.1 Mundlak (1978) Correction Probit Model

Let us consider Mobile Money implementation y_{it} in countries i = 1, 2, ..., N in periods t = 1, 2, ..., T which can be expressed as a binary choice model.

$$y = \begin{cases} 1 \text{ if } y_{it}^* \\ 0 \text{ else} \end{cases}$$

where y_{it}^* is the latent probability for a country i to receive a Mobile Money service in period t. y_{it}^* is a linear function of x_{it}, the set of time-varying observable country factors influencing Mobile Money implementation, and α_i, a set of unobservable country specific characteristics. A fixed effects probit would be adapted in order to take into account time-varying effects and constant country specific effects. However, fixed effects probit presents an incidental parameters problem, which means that the maximum likelihood estimator doesn't converge when the length of T is limited (Greene, 2004).

To avoid incidental parameters problem of fixed effects probit models, this empirical analysis is based on a Mundlak (1978) correction, which allows control of the correlation between a part of country specific characteristics and covariates. With a Mundlak approach, we suppose that a part of invariant heterogeneity between countries is correlated with time-varying covariates:

$$\alpha_i = \alpha + \bar{X}_i a + u_i$$

where $\bar{X}$ is a vector of means for some time-varying covariates for a country i over the entire period observed.

This method consists in estimating a random effects probit in which means of some

time-varying covariates are introduced, and the Mundlak correction probit model can be expressed as:

$$Prob(y_{it} = 1|X_{it}) = F(\alpha + \bar{X}_i a + X_{it} b + u_i)$$

The random effects probit model, where a is equal to 0, and the Mundlak corrected random effects probit model are compared using a Wald test. The null hypothesis is rejected and integrating means of covariates in the vector $\bar{X}$ results in a statistically significant improvement in the fit of the models. A final verification is used by identifying if the log-likelihood is improved with the Mundlak corrected model, compared to the random effects probit model. Multicollinearity between covariates is also checked to determine independent variables to keep in the model and to avoid collinearity bias. To achieve that, the variance inflation factor (VIF) is used (see Appendix II). The VIF_i is obtained by regressing the *ith* independent variable on all other independent variables. It is generally assumed that a VIF exceeding 10 and an average of all VIF much greater than 1 indicate a high and influential collinearity (Cahuzac and Bontemps, 2008; Basher and Elsamadisy, 2010), which is not the case in models tested. Finally, the quality of adjustment of the models run is tested on each model and presents a rate of good predictions higher than 90% for each model.

2.4.2 Data Collection

Longitudinal data from different data bases are collected. This collection concerns 83 emerging and developing countries, targeted by Mobile Money service providers between 2004 and 2012, a period during which first Mobile Money implementations took place. In the sample, 40 countries have benefited from non-bank-led Mobile Money until the end of this analysis. Countries implemented are identified in the "Mobile Money Deployment Tracker" by GSMA[1]. Only non-bank-led Mobile Money are taken into account. In fact, in some countries, such as Nepal, Bangladesh and Sri Lanka, private operators are not allowed to provide a MMU. Only banks can offer

[1] gsma.com

such services. In Bangladesh, only banks are allowed to offer Mobile Money with a separate license, and in Nepal, only commercial and development banks are allowed to provide these services. In the case of Sri Lanka, the Central Bank has begun to provide licenses in 2012, the last year of this study. These countries (Nepal, Cambodia, Bangladesh, India, Sri lanka, etc.), are excluded from the sample analysed, to only evaluate the implementation conditions of the alternative solutions. All Mobile Money services identified remained in activity until the end of the study (2012).

Socio-economic data collected originated mainly from World Bank Databases, especially from the "Global Findex (Global Financial Inclusion Database)", the "World Development Indicators" and the "Global Financial Development" databases. They contain macroeconomic data about economic and financial development and banking access in emerging and developing countries. In order to take into account their particularities, countries are studied according to their income level.

2.4.3 Variables choice

This analysis is conducted specifically on factors influencing the implementation of a Mobile Money service in a country. These determinants, as expressed above, are Financial Inclusion, industry location, innovation adoption and diffusion factors. Financial Inclusion is assessed within the meaning of Sarma and Peis (2011) in terms of accessibility, availability and usage of the banking system. Accessibility is approximated by the number of bank accounts per 1000 adults, availability is an index constructed with the number of ATM and bank branches per 1000 sq km, and the usage index is calculated by the aggregation of the bank deposits and bank credits to GDP ratio. These banking factors approximate both Financial Inclusion and financial experience of the inhabitants. As indicated above, the results are still to be determined, because the effects of Financial Inclusion on Mobile Money services implementation are ambiguous, and Financial Inclusion has a different impact on countries depending on their income level. As this study looks at non-bank-centric Mobile Money, the endogeneity problems are avoided. In fact, banks can react to

MMU emergence by offering themselves Mobile Money (bank-centric MMU) requiring users to hold a bank account, thus increasing the banking system accessibility. However, only few banks have offered Mobile Money to population prior to private actors' initiative regarding MMU. That was the case in Mongolia (AMAR by XacBank in 2009) and in Zambia (Xapit by Zanaco in 2008). Other banks started to react in 2011, at the end of this study (Nigeria, Papua New Guinea and Swaziland). The other countries of the chosen panel are only implemented by non-bank-centric Mobile Money, which don't require users to hold a bank account or MMU providers to deposit customers' funds in individual bank accounts.

The other factors, i.e. traditional industry location, innovation adoption and diffusion factors, seem to have a positive impact on implementation. Industry location factors, such as the mobile cellular subscriptions per 100 people approximating the market size, and the Index of regulatory quality (Kaufmann, Kraay, Mastruzzi, 2005), varying from -2.5 to 2.5, measuring the pro-business policy of the country, taking into account *"the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development"* (Kaufmann et al., 2005), compose a part of explanatory covariates. Factors related to the innovation adoption and diffusion literature compose the other part of the explanatory variables. The rate of urbanisation and the rate of labour force participation of the countries evaluate the compatibility of Mobile Money with existing needs. The gross enrolment ratio in secondary education measures the population's level of education, in order to approximate the volitional control of potential users and their self-efficacy (table (2.1)).

Finally, a lagged dependent variable is also introduced to take into account the fact that Mobile Money services observed in our panel are still operational at the end of the study, suggesting a state dependence.

Variables	Definition	Source	Expected sign
BANKACCESS	Log of Accessibility Index	World Bank	?
BANKAVAIL	Log of Availability Index	World Bank	?
BANKUSE	Log of Usage Index	World Bank	?
MOBPEN	Nb of mobile phone subscriptions per 100 people	World Bank	+
URBAN	Urbanisation growth rate	World Bank	+
LABOURFORCE	Labour participation rate	World Bank	+
EDUC	Gross enrolment in secondary education rate	World Bank	+
REGUL	Regulatory Quality Index	World bank	+
LAGGED	Dependent variable lagged	GSMA	+

Table 2.1: Independent variables: data sources and expected sign

2.4.4 Sample descritpion

On 83 emerging and developing countries observed, 40 have a Mobile Money service implemented still in activity today (see Appendix II). These services were launched between 2001 and 2012, the year this study ended, by a non-bank actor and they all offer domestic transfers to users. They have been implemented in order to fight banking exclusion by providing Financial Inclusion (easy and low-cost access to financial services).

This analysis focuses on emerging and developing countries, targeted by Mobile Money service providers, following the International Monetary Fund classification reporting in 2007. Countries are classified according to their income level (World Bank classification in 2007). In 2007, there were 179 emerging and developing economies identified in the world (IMF, 2007), 15% of which are high-income countries, 55% are middle-income countries and 30% are low-income countries. The sample studied in this paper is composed of 83 countries, 14% of which are high-income countries, 48% are middle-income countries and 38% are low-income countries. Low-income countries are slightly over-represented and middle-income are slightly under-represented, but the sample observed gives a pretty fair idea of the actual classification observed in the world in 2007. In table (2.2), are summarised characteristics of the countries

Descriptive statistics on variables used in probit model	**Whole sample (St. dev.)**		**Middle-income countries (St. dev.)**		**Low-income countries (St. dev.)**	
EDUC	68.51	(29.07)	79.17	(19.66)	38.35	(19.98)
MOBPEN	60.18	(44.32)	69.03	(38.12)	27.08	(25.16)
REGUL	-0.33	(0.78)	-0.19	(0.56)	-0.91	(0.60)
URBAN	2.49	(2.07)	1.58	(1.53)	4.22	(1.46)
LABOURFORCE	64.64	(11.54)	59.96	(8.39)	72.04	(12.25)

Table 2.2: Descritpive statistics according the countries' income level

observed, which are also variables used in the econometric regressions. Almost all indicators increase with countries' income level: the average of the gross enrolment rate in secondary education (approximating the level of education in the countries), the percentage of persons having a mobile phone, and the regulatory quality index. On the contrary, urban growth rate decreases with the income level. In fact, in middle-income countries, most inhabitants already live in urban areas (47% of inhabitants of middle-income countries live in urban areas on average in the period from 2004 to 2012). On the contrary, in low-income countries, population live essentially in rural areas (72% of the population on average in the period from 2004 to 2012), and the relatively high urban growth rate (4,22% on average compared to 1.58% in middle-income countries and 2.49% for all countries studied) attests to the large movements of population from rural areas to urban areas with the aim, amongst other things, of finding a job. Labour force participation rate is also higher in low-income countries (72.04% on average, compared to 59.96% in middle-income countries and 64.64% in all countries). If labour force is higher than other countries, it has to be interpreted carefully because it includes principally self-employed jobs, generating low earnings (Cho et al., 2012).

In order to fight financial exclusion, we expected Mobile Money service providers to implement such services in countries suffering from it, i.e. those with low indicators

of Financial Inclusion, in sense of Sarma and Peis (2011). In figure (2.1), a summary of Financial Inclusion indicators concerning the 83 countries studied is presented, according their income level. High-income countries analysis are excluded because there is no Mobile Money implemented in high income countries observed in the sample.

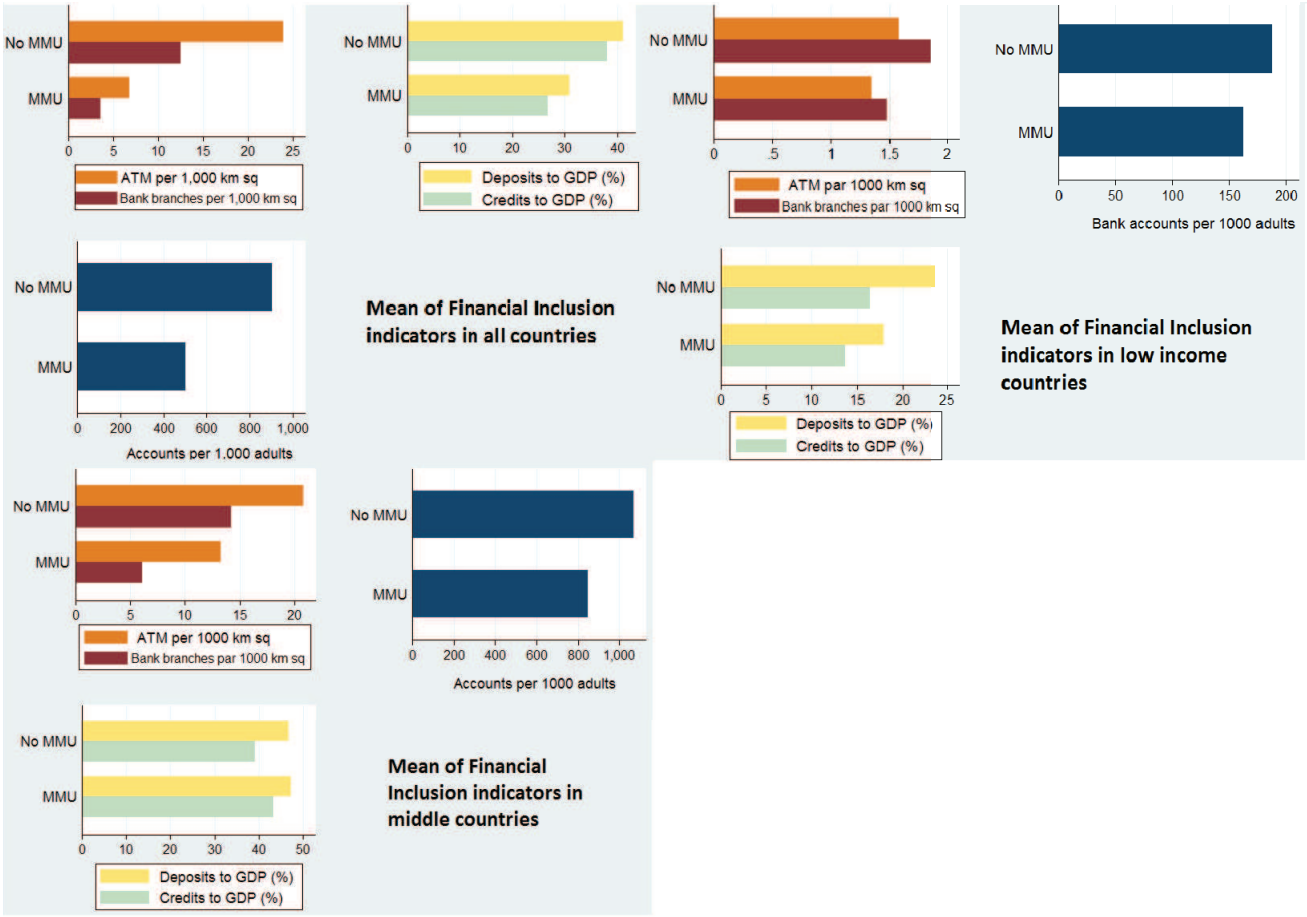

Figure 2.1: Mean of Financial Inclusion indicators

In the sample studied, this tendency seems to be confirmed. In fact, a t-test of equality of mean run on indicators of Financial Inclusion, between countries with a Mobile Money and the others, reveals that countries implemented has on average a lower inclusive banking system (see Appendix II). These results are confirmed in middle-income countries, where availability and accessibility of the banking system are lower in countries implemented. In middle-income countries these results are

pratically the same. Effectively, countries with a Mobile Money (such as Mongolia, Philippines) presents on average lower availability and accessibility indicators than countries without Mobile Money (such as Albania). This first observation confirms the adequacy of Mobile Money service providers decision and Mobile Money goals. However, middle income countries implemented use more the banking system, especially in terms of credits (t-test is statistically significant at the 10% threshold). Service providers seems to give priority to an implementation in countries in need of Financial Inclusion.

On the contrary, regarding low-income countries, Mobile Money services are not implemented in those with lower Financial Inclusion indicators. T-test run reveal no statistical differences between countries implemented (such as Afghanistan, Kenya, Madagascar, Uganda, and Zambia) and not implemented countries (such as Tajikistan, and Ethiopia). Only, usage of the banking system is statistically lower in countries implemented, revealing adequation between Mobile Money deployment and population needs in countries implemented. Therefore, at this point, it is impossible to expect correctly the impact of Financial Inclusion in Mobile Money service providers decision in low income countries.

If in the whole sample and in middle-countries Mobile Money service providers install their solution in countries with an effective need of Financial Inclusion, in accordance with MMU objectives, in low-income countries, results do not follow the same pattern.

2.5 Implementation analysis results

To understand the effective role of Financial Inclusion on service providers decision to implement a Mobile Money in a country, a Mundlak correction random probit model on longitudinal data is run (results are presented in tables (2.3) (2.4) and (2.5)). Models on banking accessibility, banking availability and banking usage are

run separately to avoid bias related to correlation between these three Financial Inclusion factors. Countries are studied according to their income level in separate models (whole sample, middle and low-income countries groups) to identify tendencies on each subgroup.

The identified and noticeable ambiguity of the role of Financial Inclusion in Mobile Money implementation decision, revealed in Mobile Money literature, seems to make real sense. In terms of banking infrastructures availability, results are contrasted according the countries' income level. Effectively, availability appears to have a positive and significant impact on Mobile Money implementation both in the whole sample and low-income countries models. However, it has no impact in middle-income countries. A positive impact of banking infrastructures availability can be explained because these services are not totally independent from the banking system. As explained previously, the agent network cannot operate without banking infrastructures. They are only allowed to provide financial services but are not recognised as banks or deposit takers. Mobile Money agents need to be close to banking infrastructures in order to manage users' cash deposit and withdrawals. That is why some authors, like Alexandre and Eisenhart (2013), talked about "banking beyond branches" to define Mobile Money services. In low-income countries, with very limited banking infrastructure availability indicator, compared to middle and high-income countries, Mobile Money providers need for a sufficient level of banking infrastructures in order to provide their financial services. Once this level is reached, MMU providers can implement their services and focus their efforts in countries with a relative lack of banking infrastructures. These results are compatible with enabling domestic determinants stated in Mobile Money literature (Mas and Morawczynski, 2009; Camner and Sjöblom, 2009; Camner et al., 2010; Mas and Radcliffe, 2010; Merritt, 2011; Bosire, 2012). In middle-income countries, where a sufficient level of banking infrastructure availability is reached (availability indicator is higher in average than in low-income countries), MMU providers can install their solution in every country, and availability of the banking system is not anymore a key point in their decision.

	Implementation of Mobile Money for Unbanked services in the whole sample					
	Banking services Accessibility Model		**Banking services Availability Model**		**Banking services Usage Model**	
Variables	Probit with Mundlak Correction	Marginal Effects	Probit with Mundlak Correction	Marginal Effects	Probit with Mundlak Correction	Marginal Effects
LAGGED	7.39	0.66	7.66	0.62	7.46	0.62
	[0.17]***	[0.09]***	[0.25]***	[0.08]***	[0.22]***	[0.07]***
BANKACCESS	0.44	0.04				
	[0.39]	[0.03]				
BANKAVAIL			0.75	0.06		
			[0.43]*	[0.03]*		
BANKUSE					0.71	0.06
					[0.56]	[0.04]
REGUL	1.36	0.12	0.95	0.08	1.59	0.13
	[1.03]	[0.09]	[0.92]	[0.08]	[0.97]	[0.08]
URBAN	0.26	0.02	-0.007	-0.0006	0.17	0.01
	[0.26]	[0.02]	[0.19]	[0.02]	[0.14]	[0.01]
LABOURFORCE	-0.10	-0.009	-0.004	-0.0003	-0.02	-0.001
	[0.15]	[0.01]	[0.08]	[0.007]	[0.08]	[0.007]
MOBPEN	0.009	0.0008	0.006	0.0005	0.01	0.0008
	[0.006]	[0.0006]	[0.007]	[0.0006]	[0.007]	[0.0006]
EDUC	0.05	0.005	0.04	0.003	0.06	0.005
	[0.03]**	[0.002]**	[0.03]	[0.002]	[0.02]**	[0.002]**
Observations	333		470		495	
Wald chi2	19.26		22.86		26.78	
Wald test	[0.000]		[0.000]		[0.000]	

Robust standard errors are given in parentheses. The symbols *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 2.3: Whole sample: Random Probit Regressions with Mundlak Correction Results and Wald tests

This ambiguity of the Financial Inclusion role is also revealed by the results regarding the banking services accessibility. Indeed, if accessibility (approximated by an index constructed with the number of bank accounts per 1000 adults) appears to be significantly involved in Mobile money implementation both in low and middle-income countries. Even if this result is inconsistent with the objectives of Mobile Money services, it is not meaningless. As noted previously, Mobile Money service providers need to find a potential customer base in order to make a decision on the implementation of their financial services. To reach users, Mobile Money must be compatible with past experiences and it must be trialable in order to be adopted. The compatibility with past experiences and the innovation trialability can be related to financial knowledge and experience of the population (Financial Literacy). So, to ensure Mobile Money adoption, MMU providers must make sure they meet an informed (and maybe experienced) population about financial services. Financial

	Implementation of Mobile Money for Unbanked services in middle-income countries					
	Banking services Accessibility Model		**Banking services Availability Model**		**Banking services Usage Model**	
Variables	Probit with Mundlak Correction	Marginal Effects	Probit with Mundlak Correction	Marginal Effects	Probit with Mundlak Correction	Marginal Effects
LAGGEDIMP	7.37	0.62	7.44	0.58	7.32	0.58
	[0.29]***	[0.11]***	[0.36]***	[0.10]***	[0.25]***	[0.10]***
BANKACCESS	1.85	0.16				
	[1.09]*	[0.09]*				
BANKAVAIL			0.20	0.01		
			[1.01]	[0.08]		
BANKUSE					1.01	0.08
					[1.26]**	[0.09]
REGUL	2.89	0.24	3.09	0.24	2.98	0.23
	[1.78]	[0.16]	[1.53]**	[0.12]**	[1.61]*	[0.13]*
URBAN	0.59	0.05	0.84	0.06	0.97	0.08
	[0.47]	[0.04]	[0.49]*	[0.04]*	[0.50]*	[0.04]*
LABOURFORCE	-0.14	-0.01	-0.11	-0.008	-0.14	-0.01
	[0.17]	[0.01]	[0.18]	[0.01]	[0.18]	[0.01]
MOBPEN	0.006	0.0005	0.02	0.001	0.01	0.001
	[0.009]	[0.0008]	[0.009]**	[0.0007]*	[0.008]*	[0.0007]*
EDUC	0.04	0.003	0.004	0.0003	0.004	0.0003
	[0.04]	[0.003]	[0.03]	[0.003]	[0.03]	[0.002]
Observations	206		256		263	
Wald chi2	24.69		17.29		23.39	
Wald test	[0.0004]		[0.0083]		[0.0007]	

Robust standard errors are given in parentheses. The symbols *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 2.4: Middle-income countries group: Random Probit Regressions with Mundlak Correction Results and Wald tests

experience and knowledge, revealed by a sufficient accessibility to bank accounts, would be the necessary innovation trial and would ensure the compatibility with the population's past experiences. These results are compatible both with innovation adoption (Rogers, 1993) and Mobile Money adoption (Camner et al., 2010) literature. However, this result cannot be confirmed by the impact of banking system usage which has a no significant on Mobile Money implementation.

Results in middle-income countries, in terms of socio-demographic factors, are pretty consistent with literature. Mobile Money implementation is enhanced by the market size (mobile penetration), the pro-business policy of the country and the urban growth rate. The positive and significant impacts of these determinants are supported by firms location literature (Davidson, 1980; Krugman, 1990, Wheeler and Moody, 1992; Holmes, 1998; Hines, 1999; Devereux and Griffith, 2002), search-theoretic literature applied to monetary issues (Kiyotaki and Wright, 1993; Katz and Shapiro, 1994; Berentsen, 1998; Shapiro and Varian, 2000; Rysman, 2004; Chou et al., 2004; Orléan, 2008), innovation adoption literature (Rogers, 1993), and finally in Mobile Money literature (Camner et al., 2010; Heyer and Mas, 2009; Bosire, 2012). MMU service providers offer free and low cost financial services and to make their activity profitable they need to meet a large customer base, explaining the positive impact of the market size on the MMU providers decision. The positive effect of the urban growth rate attests to the movements from rural to urban areas, especiallyregarding job opportunities, which are switching from agriculture to industry in these countries (Cho et al., 2012). These population movements represent a potential in domestic money transfers. Finally, the positive and significant effect of the pro-business policy of the country, a traditional factor of industry location, confirms the necessity for service providers to meet an enabling business environment to run their activity.

In low-income countries, tendencies are not totally similar. Only the labour force participation and the level of education have a significant impact. The negative impact of the labour force participation rate can be explained by the high rate of

	Implementation of Mobile Money for Unbanked services in low-income countries					
	Banking services Availability Model		**Banking services Usage Model**		**Banking services Accessibility Model**	
Variables	Probit with Mundlak Correction	Marginal Effects	Probit with Mundlak Correction	Marginal Effects	Probit with Mundlak Correction	Marginal Effects
LAGGEDIMP	7.90	0.76	7.15	0.73	10.69	0.63
	[0.77]***	[0.14]***	[0.36]***	[0.13]***	[0.91]***	[0.18]***
BANKAVAIL	1.50	0.14				
	[0.61]**	[0.06]***				
BANKUSE			0.39	0.04		
			[1.11]	[0.11]		
BANKACCESS					3.07	0.18
					[1.42]**	[0.08]**
REGUL	0.32	0.03	1.59	0.16	-5.15	-0.30
	[1.02]	[0.09]	[1.65]	[0.17]	[3.46]	[0.19]
URBAN	-0.87	-0.08	-1.89	-0.01	0.47	0.03
	[0.65]	[0.06]	[1.16]	[0.03]	[1.54]	[0.09]
LABOURFORCE	-0.14	-0.01	-0.15	-0.01	-6.02	-0.35
	[0.09]	[0.007]*	[0.08]*	[0.008]*	[2.35]**	[0.12]***
MOBPEN	0.01	0.001	0.01	0.001	0.03	0.002
	[0.02]	[0.002]	[0.02]	[0.002]	[0.03]	[0.002]
EDUC	0.07	0.007	0.15	0.02	0.61	0.03
	[0.06]	[0.006]	[0.06]***	[0.006]***	[0.27]**	[0.01]**
Observations	144		156		90	
Wald chi2	27.24		15.51		11.17	
Wald test	[0.0001]		[0.0166]		[0.0831]	

Standard errors are given in parentheses. The symbols *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 2.5: Low-income countries group: Random Probit Regressions with Mundlak Correction Results and Wald tests

self-employed workers (Cho et al., 2012). If self-employment increases the labour force participation, it generates low earnings for workers. The high number of poor workers decreases the potential market for savings and money transfers, discouraging implementation of new financial services. The level of education has a positive impact on Mobile Money implementation in low-income countries. In fact, education is a way to eliminate or reduce volitional control factors, minimising the lack of skills and abilities necessary to adopt MMU services (Ajzen, 1985, 1991) and it is a way to enhance users' perception of their self-efficacy (Taylor and Todd, 1995; Khraim et al., 2011). Mobile Money service providers need to meet an educated population, with writing and reading skills, to ensure the usage of their services, delivered via SMS or Internet platform technologies. In addition, an adequate level of education promotes the perceived self-efficacy of a population which will be confident in its capacities and more likely to adopt new financial services offered by MMU.

Resulting from this implementation analysis, the Mobile Money paradox is enlightening. MMU financial services are designed to provide low-cost and easily accessible financial services in order to fight financial exclusion, especially banking exclusion. These services emerge as an alternative to banking system, with the aim to integrate into the financial system people who are excluded from it. However, in reality, Mobile Money service providers need to meet a sufficiently developed banking system to operate, especially in terms of banking infrastructures availability. Moreover, a population having some education and some experience in finance is a key factor in the adoption and diffusion of the MMU innovation, the target-objective of Mobile Money providers. Offering a financial alternative and innovation, based on and linked to the traditional financial system, represents the Mobile Money paradox. If Mobile Money service providers are still dependent of banking system, this innovation can conduct to a double exclusion for certain countries, both from the banking system and from the financial innovating solutions, especially in low-income countries.

2.6 Adequacy between implementation determinants and adoption factors

The second part of this study is conducted in order to understand if adoption is motivated by the same factors than implementation. In which countries is Mobile Money most successful? Is it in countries with the largest Financial Inclusion difficulties, or on the contrary, is it more adopted in countries with a relatively inclusive banking system? If Mobile Money service providers need to meet favourable conditions to implement their financial services, are these conditions the same that make adoption successful? MMU providers chose to set up in countries with high adoption potential, as mentioned previously. But are these characteristics identical to those which have motivated implementation? Adequacy between necessary conditions for implementation, supply side requirements, and demand needs and specificities, demand side characteristics, is analysed so as to understand if Mobile Money is a relevant instrument to fight financial exclusion.

2.6.1 Mobile Money Adoption Cluster Analysis

To adress the issue of accordance between determining factors in implementation and adoption, this study is conducted on 35 countries having at least one bank-led and non-bank-led Mobile Money in 2011, to determine if these two solutions have the same inclusive potential. Then, a clustering analysis is run on countries in which only a non-bank-led Mobile Money service has been implemented. This last study is conducted on 25 countries to understand adotpion factors of the Mobile Money alternative, both to identify determinants factors of adoption and to evaluate the adequacy of these factors with MMU supported goals.

Cluster analysis produces groupings of data into natural groupings, in order to organise them, according to their similarity. The goal is to create several distinct groups in which objects of study are similar. It means that groups will be constituted by maximising the distance interclass and minimising the distance intraclass.

The purpose of this adoption factors analysis is to regroup countries according to their level of adoption and the number of years passed since the first MMU was implemented, to merge countries with homogeneous adoption characteristics. Then it will be possible to determine in which class there is the highest rate of adoption and to describe characteristics from these groups. To perform this study, the Ward's minimum-variance method is used. It has been chosen preferably from other hierarchical cluster algorithms because of its better predictive potential tested and attested in numerous studies based, for instance, on the Euclidean distance or the Rand Index (Becker et al., 2011; Ferreira and Hitchcock, 2009). At the beginning, the number of clusters is unknown and this analysis starts by attributing each individual to a distinct cluster. Clusters are progressively merged according to a minimised variance between two clusters merged. Ward's method for cluster stops when it remains only one cluster. To determine the optimal number of clusters, different methods can be used. In this analysis, three of them have been tested: the Duda and Hart Index, the Calinksi and Harabasz Index and the realisation of a dendrogram. The Calinksi and Harabasz Index is defined as:

$$CH(K) = \frac{trace(B)/(K-1)}{trace(W)/(N-K)}$$

where N is the number of observations, K the number of groups, $trace(B)$ is the between-cluster sum of squared distances and $trace(W)$ is the within-cluster sum of squared distances. The value of the Calinksi and Harabasz Index is high when the number of groups is optimum.

The Duda and Hart Index is expressed as:

$$DH = \frac{J_1^2(m)}{J_2^2(m)}$$

where $J_1^2(m)$ is the within-cluster sum of squared errors of the mth cluster, $J_2^2(m)$ the within-cluster sum of squared distances when the mth cluster is optimally divided into two. The value of the Calinksi and Harabasz Index is high when the number of groups is optimum.

These index results are completed and checked by a visual confirmation via the dendrogram produced (see Appendix II for results from the Duda and Hart Index, the Calinksi and Harabasz Index, and the dendrogram).

2.6.2 Variable choices

To understand the determinants of Mobile Money adoption, the variables observed are pretty similar to those studied in Mobile Money implementation. In fact, MMU services providers decide to set up in countries with sufficient adoption potential. These determinants refer to the innovation adoption literature cited previously. Obviously, banking factors, in terms of accessibility, availability and usage of the banking system, are taken into account, expressing the real need, the past experience, the ability and the self-confidence of the potential users (Ajzen, 1985, 1991; Rogers, 1993; Taylor and Todd, 1995; Khraim et al., 2011). Here, accessibility is assessed in a different way than in the implementation analysis. The rate of adults having a bank account is used, this variable being observable only in 2011 (Findex, World Bank). Again, the expected influence of banking factors remains to be determined, as mentioned previously. Education level of the population is also included to evaluate its real abilities to use Mobile Money innovation (Ajzen, 1985, 1991). The level of education is expressed by the average number of years of schooling of the population. The information being not always available for 2011, data for 2009 or 2010 are then used. The rates of a country urbanisation and of its labour force participation evaluate the compatibility of Mobile Money with existing needs (Rogers, 1993).

2.6.3 Data Collection

In this clustering analysis, countries are regrouped according their rate of Mobile Money adoption and the number of years passed since the first MMU was implemented. A central database on Mobile Money adoption is currently emerging, pro-

vided by IMF through the Financial Access Survey (FAS). The database provides the number of Mobile Money accounts in countries implemented. However, if this database is still incomplete, not all countries having a Mobile Money are recorded, it has been completed by a search on different sources of information. These sources are various: reports[2], official speeches[3], interviews[4], case studies[5], corporate annual reports[6], company press releases[7], and conference presentations[8].

The number of years passed since the first MMU was implemented is obtained in the GSMA Mobile Money Tracker which provides the year and month of implementation. Then, the number of years passed until the end of 2011 is calculated.

Macroeconomic variables about countries' characteristics have been found in the World Bank database, including World Development Indicators, Education Statistics, Jobs and Findex.

2.6.4 Sample description

The sample observed (figure (2.2)) is composed of 35 countries, 19 countries of which are low-income countries and 16 are middle-income countries. Mobile Money systems observed are both bank-led and non-bank led systems.

On average, Mobile Money adoption rates are quietly similar between middle and low-income countries (5.36% compared with 4.74%) with the exception of Tanzania and Kenya. In fact, these two countries reach considerably higher adoption rates

[2]UNCTAD, Afghanistan (2011), Burundi, Rwanda, Tanzania and Uganda (2012); GSMA (2014), Côte d'Ivoire; OITFM (2013), Haiti; State Bank of Pakistan (2011); GSMA (2012), Thailand.

[3]Botswana's transport and communication ministry (2014).

[4]mPAY Managing director (2011), Thailand.

[5]UNDP, Burkina Faso, Xacbank Mongolia (2011); World Bank, Ghana (2011); NAWC, Morocco (2011); CGAP (2012), Senegal; CGAP (2011) and IFC (2011), South Africa.

[6]MTN Sustainability report (2011), Benin, Ghana, Liberia and Zambia; France Telecom Overview of business (2011), Mali; Vodacom Integrated report (2012), South Africa.

[7]GCS International (2014), Dominican Republic.

[8]Mobile Money APAC 2012 conference, Mongolia; IFC (2012), Paraguay.

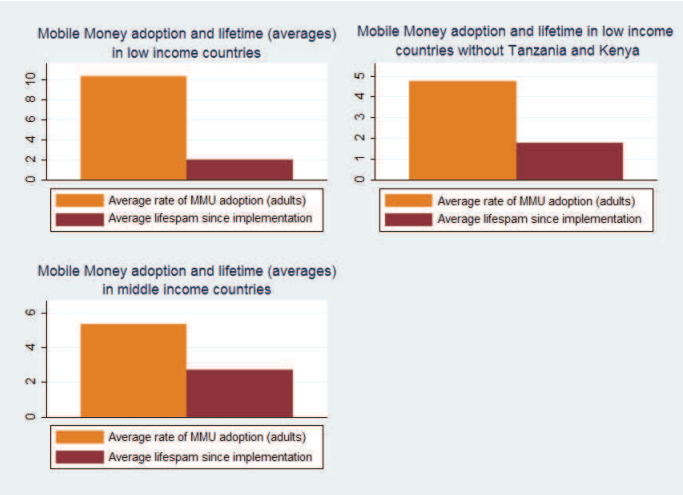

Figure 2.2: Mobile Money adoption and lifespan (on average) according the countries' income level

than other countries, i.e. 36% of the adult population for Tanzania and 79% for Kenya. By contrast, by observing only non-bank led Mobile Money (figure (2.3)), adoption rates are higher in middle-income countries than in low-income countries (6.26% compared with 4.99%). This observation goes against Mobile Money objectives. As mentioned previously in the implementation analysis section, middle-income countries suffer less from financial exclusion than low-income countries, and if they remain Mobile Money target for Financial Inclusion, they do not represent countries with the largest Financial Inclusion difficulties. On the basis of the implementation analysis, a double exclusion is detected for countries with a low banking access, which could be reinforced by adoption results. In fact, if countries with a low banking access are not favourite target countries, they seem to be also countries where Mobile Money is not the most successful. However, it should be noted that if higher adoption rates are observed in middle-income countries, Kenya and Tanzania, with the highest rates of adoption, belong to low-income countries.

This finding requires the taking into account of MMU service life. Indeed, the longer a Mobile Money has been in existence, the more likely it is to be adopted, because inhabitants had sufficient time to get familiar with and informed on Mobile Money services. On average, MMU service life of non-bank-led MMU is longer in middle-income countries than in low-income countries (more than 3 years compared with

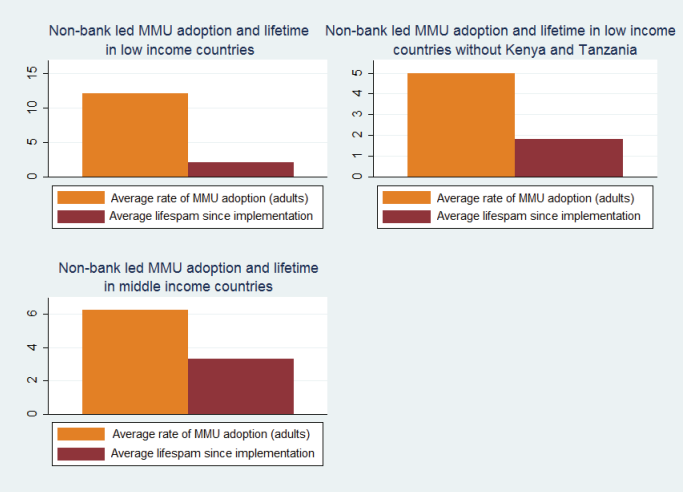

Figure 2.3: Non-bank-led Mobile Money adoption and lifespan according the countries' income level

less than 2 years). This confirms the results obtained in the implementation analysis and indicating that Mobile Money providers have first set up their financial solution in countries with a relatively inclusive banking system.

2.7 Adoption analysis results

In order to confirm these first observations, a clustering analysis is run to regroup countries with similar Mobile Money rates of adoption and lifespan. Five clusters are constructed, two of them being composed by only one country, Kenya and Tanzania, which present higher adoption rates no comparable with the rates of the other countries studied.

The clustering analysis (table(**??**)) reveals three different groups of similar countries in terms of Mobile Money adoption and service life (Kenya and Tanzania, each country composing a distinct group, are excluded from this study). Cluster 1 can be defined as the group of countries which have been implemented for a short time (approximately a year and a half) and where MMU is not well spread (2.07% of adults). Cluster 2 can be defined as the group of countries which have also been implemented for a short time (just below 2 years, on average duration quasi similar

	CLUSTER 1	CLUSTER 2	CLUSTER 3	CLUSTER 4	CLUSTER 5
Countries observed	Liberia, Paraguay, Burkina Faso, Morocco, Burundi, Sierra Leone, Afghanistan, Benin Malaysia, Mali Nigeria	Indonesia, Zambia, Madagascar, Mongolia, Rwanda, Colombia Somalia	Thailand, Uganda, Côte d'Ivoire, Senegal, Philippines	Tanzania	Kenya
Rate of MMU adoption	2.07	5.54	13.21	35.99	79.39
Service life of MMU in year	1.64	1.93	5	3.2	4.3

Variables	CLUSTER 1	CLUSTER 2	CLUSTER 3
GDP per capita	1415.72	1446.08	1336.41
ATM per 1,000 sq km	9.11	6.70	40.95
Bank branches per 1,000 sq km	4.02	4.64	8.03
Bank accounts (% of adults)	21.73	31.19	31.37
Deposits to GDP (%)	39.24	28.59	45.10
Credit to GDP (%)	34.11	28.30	47.35
Mobile penetration (%)	73.14	66.49	84.51
Mobile network (% of population covered)	74.09	75.5	96.2
Years of schooling	5	7.12	5.90
Labour force (%)	64.69	71.7	71.54
Urban growth (%)	3.90	3.54	3.37

to Cluster 1) and where MMU is more widely spread than in Cluster 1 (5.54% of adults). Cluster 3 is composed of countries which has been implemented for a longer time than the other clusters (5 years), and where MMU is more widely spread than in the other clusters (more than 13% of adults). All the results are confirmed by the run of a t-test revealing significant differences.

A comparison of countries characteristics between different clusters is run to identify which factors could explain the differences in MMU adoption rates (see Appendix II).

The success of Kenya and Tanzania is often studied (Mas, 2009; Heyer and Mas, 2009; Camner and Sjöblom, 2009; Jack and Suri, 2011). Numerous arguments have been presented in case studies to explain Mobile Money success in these two countries. These factors of success emerge from different sources: MMU and service providers' characteristics on the one hand and countries' specificities on the other. MMU and service providers' characteristics consist principally in the ease of use of the Mobile Money service (Mas and Morawczynski, 2009), in a large enrolment of retail businesses as agents (Camner and Sjöblom, 2009; Mas and Morawczynski, 2009), in a high control of agents distribution (Mas and Morawczynski, 2009), and in the trust in MMU provider (Camner and Sjöblom, 2009; Heyer and Mas, 2009), the traditional factors of innovation adoption (Davis et al., 1989; Davis, 1989, 1993; Rogers, 1993). Countries characteristics are mainly: a relatively available banking system (Camner and Sjöblom, 2009), a large population awareness of financial services (Camner and Sjöblom, 2009), an increasing urbanisation (Heyer and Mas, 2009) and a high mobile penetration along with a large mobile network coverage (Mas and Morawczynski, 2009). These two countries seem to present favourable specific conditions enabling adoption and will not be studied anew in this clustering analysis.

MMU and providers' characteristics could not be taken into account in this study because of the impossibility to ascertain the rate of adopters for each service provider. A comparison between qualities of services has not been realised. This analysis focuses on countries' specificities. Mean and variance t-tests are effectuated to understand the differences between countries composing the different clusters and identified why MMU is not successful in every country observed. A statistical difference is observed in terms of banking infrastructure availability between Cluster 3 and the two others (statistically significant at the 5% threshold). In fact, this cluster has an higher availability indicator than the two others (0.16 compared with 0.05 in Cluster 1 and 0.04 in Cluster 2). This observation confirms results found in the implementation analysis. Indeed, Cluster 3 is also the cluster with the higher Mobile Money service time, expressing the need for MMU providers to benefit from the banking

infrastructures to run their activity. The mobile network is also statistically wider in Cluster 3 than in two others (96.2% of the population covered by the mobile network on average in Cluster 3 compared with 74% in Cluster 1 and 75.5% in Cluster 2). This significant difference (significant at the 1% threshold) could also explain why these countries have been implemented earlier than the other countries. In fact, to deploy their financial services and to ensure adotpion, MMU providers need to connect a significant part of the global population via the mobile network. These two differences are the only significant ones, possibly because of the small size of the sample, and they cannot explain differences of adoption between Cluster 1 and Cluster 2. However, there are several specificities revealed from Cluster 1, which is also the cluster in which Mobile Money services are the least successful. Firstly, countries from Cluster 1 are less widely included in the banking system, in terms of having a bank account and usage of banking services (on average 21% of the population have a bank account in Cluster 1, compared with 31% both in Cluster 2 and Cluster 3). Secondly, population from Cluster 1 is also the less educated. Indeed, in this cluster, people have on average being to school for 5 years, which is one year shorter than in Cluster 3 and two years shorter than in Cluster 2.

The results confirm a Mobile Money paradox. If such a paradox exists in terms of implementation, it also exists in terms of adoption. This kind of observations has already been highlighted in some studies. They actually reveal that early adopters of Mobile Money services are principally banked people (Jack and Suri, 2011) and more educated people (Van den Bulte, 2000; Chia et al, 2006; Ndiwalana et al., 2011; Tobbin and Adjei, 2012). In fact, if Mobile Money implemented in emerging and developing countries suffering from banking exclusion meet existing needs, it still requires adequate conditions to be adopted. Indeed, Mobile Money has to be compatible with prior experiences in the field of financial knowledge and experience (Financial Literacy). Empirical literature on digital services has already revealed the divide caused by electronics innovation, the adoption of which is promoted by the users' past experience (Le Guel et al., 2004). Some studies discuss the necessity to inform and educate population to Mobile Money innovation, because of the

lack of financial services knowledge of the target population (Camner and Sjöblom, 2009; Mas and Morawczynski, 2009), this knowledge being a key factor in adoption. Moreover, a country's population needs to reach an adequate level of education to avoid the volitional control factors (Ajzen; 1985, 1991). Indeed, potential users must have the necessary abilities to adopt Mobile Money, principally literacy skills, and a sufficient perceived self-efficacy (Taylor and Todd, 1995; Khraim et al., 2011), i.e. a good perception of their ability adequacy to use innovation, capacities that can be both improved by education. Results from this clustering analysis reveal the same problems evocated in innovation adoption literature (Ajzen; 1985, 1991; Taylor and Todd, 1995; Le Guel et al., 2004; Khraim et al., 2011) and Mobile Money adoption literature (Camner and Sjöblom, 2009; Mas and Morawczynski, 2009). These difficulties have to be considered by Mobile Money service providers and MMU supportive entities (governments, supportive lobbies and fondations).

2.8 Concluding remarks

Mobile Money service is designed to fight financial exclusion by offering low-cost and easily accessible financial services. Contrary to its objectives, Mobile Money services need to meet a relatively well inclusive banking system to be set up. Indeed, Mobile Money services could not be considered independently from the banking system. It is a "banking beyond branches" solution (Alexandre and Eisenhart, 2013). To run their financial services activity, Mobile Money service providers need to find a suitable and available banking infrastructure, especially if they want to be able manage their cash and provide good quality services ensuring adoption. In addition, the adoption of financial services, as Mobile Money, necessitates a prior knowledge and experience of such services. That is why, unlike its objective of fighting financial exclusion, Mobile Money is not the most successful in countries affected by a most lack of banking access.

Mobile Money dependence on banking system generates two kinds of issues. The de-

pendence on banking system is the very reason why Mobile Money service providers do not always choose countries with the largest deficiency in banking access and infrastructures availability, which would be however in accordance with their objective to fight financial exclusion. In low-income countries, highly affected by banking exclusion, the difficulty of Mobile Money service providers to implement their services reinforces the country's financial exclusion. This situation leads in fact to the double exclusion of low-banking countries: a banking exclusion and an exclusion from innovative financial solutions (such as Mobile Money). On the one hand, these countries are likely to be increasingly excluded from financial services by the fact that the solutions currently designed are not totally independent from the existing banking infrastructures. On the other hand, the dependence on the banking system, which makes it necessary to dispose of a system that is sufficiently inclusive reinforces the double exclusion problem for population from low-banked countries. However, if Mobile Money providers succeed in setting their financial services in low-banked countries, this innovation is less likely to be adopted there than in better banked countries. Mobile Money adoption is dependent on prior financial experience and current knowledge of potential users. Banked people are more likely to adopt this innovation than unbanked people.

To address a part of this paradox, solutions have already been implemented by the central banks concerned. To ensure the disconnection of MMU financial services from the banking system, in order to turn them into an independent and a real financial alternative, some central banks have granted licenses to enable Mobile Money providers to issue electronic money. These licences enable them to propose financial services that are both more disconnected from banks and extended compared to the services they currently offer. For example, in 2011, the Central Bank of Sri Lanka has allowed non-bank financial service providers to offer these services. A Mobile Money has been launched in 2007, before the regulation, and customers need a bank account to use the system. Deep changes are currently detectable, on the way of a larger licensing of non-bank actors. As an example, Orange Money is obtaining a licence for the right to issue electronic money, without banking partners. If regu-

lation is becoming more and more flexible, it requires a minimum of protection for users' funds. Even the most permissive regulation demands at least that customers' funds be deposited in a banking institution. Consequently, Mobile Money providers cannot reduce their dependency on the banking system. A solution could be to promote exchanges without cash. Indeed, MMU providers dependency on banking system is maintained by their necessity to manage the users' cash. Two kinds of solutions can be proposed. The first one concerns regulation. In fact, Mobile Money providers are still not allowed to act as "deposit takers". If they had the possibility to take deposits from subscribers, they could encourage employers to distribute wages via Mobile Money wallets, or initiate collaborations with public institutions to dematerialise taxes and transfer incomes. However, bank lobbies are contesting this possibility. In Kenya, the "banking fraternity" denounces unfair competition between banks and Mobile Money providers. It wants MMU providers to be regulated by the same prudential regulations than banks or to be restricted as to the amounts they can take. As the status of "deposit takers" seems to be still difficult to obtain for non-bank actors, another solution can be proposed. In order to reduce providers' dependency on the banking system, users' dependency on cash should be reduced. This dependency doesn't enable providers to disconnect their services from the banking system, they will always need to be close to a bank branche to manage cash deposits and withdrawals. To achieve that, MMU providers could promote and develop acceptance of their Mobile Money among shopkeepers. By developing a retail merchants network accepting Mobile Money payments, MMU providers may encourage dematerialised transactions which need no cash withdrawal or deposit.

The Mobile Money paradox also highlights the Financial Knowledge issue. Education and financial education appear to be the key element in Mobile Money adoption as an instrument of Financial Inclusion. Population must be aware of financial and Mobile Money services available. To inform and educate a population, Mobile Money service providers have understood the importance of deploying an important network of agents, playing the role of educators. MMU providers and practitioners claim this necessity to deploy an extensive network of agents in order

to raise awareness and educate population to Mobile Money and financial services (Davidson and Leishman, 2010; McKay, and Pickens, 2010; Flaming et al., 2011). Furthermore, local agents, licensed and delegated by MMU providers, are employees or retail shopkeepers, often already known by the local population. Their proximity to local population enables them to educate population and promote Mobile Money services in a climate of trust and confidence, a factor leading to a mass adoption of Mobile Money.

Chapter 3

Social mobile money: key flows and processes in designing an inter-organisational technological platform

3.1 Introduction

Knowledge is a valuable and critical resource for organisations, particularly in the current information society. It has become a key asset and an important competitive edge for organisations that are more intent on knowledge than on labour (Nonaka, 1991). Although the definition of knowledge has been widely debated, a precise description of knowledge has not been proposed. Several taxonomies have, however, been built that make the distinction between tacit-codified, individual-collective, private-public, component-architectural, and complementary-supplementary knowledge. Regarding these taxonomies, as it flows, knowledge can be tangible or intangible. As Nissen (2006) explained, knowledge is a competitive resource for which capitalisation depends upon its flows. In the knowledge management literature, several works have developed static and dynamic models representing the phenomenon

of knowledge flows and how they can be managed. From a technological point of view, Leavitt (1965) and Davenport (1993) explained that knowledge flow requires the existence or the design of information systems (IS) along with corresponding organisation and process characteristics.

In this chapter we ask whether knowledge as a tangible asset could contribute to the elaboration of the IS destined to facilitate such knowledge flows in a collective innovation context. In other words, the present research uses the taxonomy component-architectural model to analyse the role of knowledge flows in designing an interorganisational artefact. It focuses on the "business ecosystem" concept introduced by Moore (1996), defined as a collaborative space dedicated to innovation that is characterised by strong interdependencies between firms from different sectors. In such a complex inter-organisational environment, the technological platform structures the business ecosystem (Gawer and Cusumano, 2002; Iansiti and Levien, 2004; Isckia, 2011). In the industrial sector, for instance, the platform is associated with a subsystem that is the core global system and provides flexible coordination via interfaces between components produced by specialised firms (Baldwin and Woodard, 2009). This is the case of Microsoft Windows and Linux, Intel and ARM microprocessors, iPod, iPhone and iPad by Apple, game consoles, debit cards, and so on. The platform is the starting point for an inter-organisational innovation process (Iansiti and Levien, 2004). However, few works have highlighted the reasons why technological platforms are the basis of a business ecosystem (Parker and Van Alstyne, 2005; Hagiu, 2007a, b; Gawer and Cusumano, 2012).

In the following, we address the design process of the technological platform for the new digital business ecosystem, more precisely the new Near Field Communication (NFC) ecosystem, developed around a social mobile money innovation. As Madl-

mayr and Scharinger (2008) explained, in the NFC ecosystem several technical and strategic issues have to be dealt with to enable its emergence. From this point of view, the present research aims to analyse how knowledge flows contribute to resolving these issues. The main objective is to identify which knowledge flows are key elements for designing an inter-organisational technological platform. As a first step, we identify the role of a technological platform in a digital business ecosystem, and particularly its main characteristics. Second, we use architectural innovation theory (Henderson and Clark, 1990; Anderson et al, 2008) in order to develop an analysis grid that is helpful in identifying and analysing the role of architectural knowledge in the technological platform design. Third, after presenting our methodology and our experimental work - *technological platform based on NFC* - we discuss our results and show that architectural knowledge comprises key flows and processes that structure the emergence of the digital business ecosystem.

3.2 Technological platform typology: the conditions for the emergence of an industrial technological platform

According to the typology outlined by Gawer and Cusumano (2012), technological platforms may be "internal" or "external", closed or open. There are three types of platforms: internal, supply-chain and industrial.

Internal platforms are *a set of components organised in a common structure from which by-products may be efficiently developed and produced* (Muffato and Roveda, 2002). According to Gawer (2010) and Gawer and Cusumano (2012), an internal platform may evolve into a "supply-chain platform". In this case, the platform is a key tool that can improve firms' productivity by reducing costs related to the

regular use of modular components. They can also provide the firm with access, at lower cost, to the new innovations, technologies, or essential components that it cannot control.

Internal and supply-chain platforms are different from industrial platforms. First, the nature of relations (commercial or otherwise) between the firms involved is different. In the case of industrial platforms (external platforms, called open platforms), firms develop complementary innovations and they are not necessarily bound by a client-supplier relation. They are part of the same value chain and share the same market strategy, like the Windows and Apple apps. The product, service, or final use can be incomplete, sometimes deliberately. This product is not predefined but is dependent on its level of openness, in particular its capacity to attract external actors to innovate and enrich the value proposition of the platform. Second, demand is for the whole system that creates value for the set of components, while each component separately could not attract demand (Gawer and Henderson, 2007). The platform interface must be open enough to enable external actors - *outside firms* - to enrich it by addition, innovation, or development of complementary assets. This third characteristic determines the development of niche activities and, in consequence, survival of the ecosystem (Iansiti and Levien, 2004). However, not every product, service, or technology can fulfil the role of industrial platform. A number of conditions need to be in place for an industrial platform to emerge.

It can first be an internal platform and switch to a supply-chain platform and/or an industrial platform provided that three conditions are fulfilled (Gawer, 2010, p.28):

- external firms can enrich the value of the platform's components;
- the value for customers is created less by the assembler of components than the components themselves;
- component actors can benefit from different market opportunities as before.

More generally, the emergence of an industrial platform ecosystem must meet certain conditions (table (3.1)) (Iansiti and Levien, 2004; Gawer and Cusumano, 2012):

Conditions to develop	Means to be employed
Identifying how a product, a technology or a service may become the structuring element of business ecosystem	Creating or identifying an element which can be a platform where complementary elements will be connected and assure a central function in business ecosystem.
	Identifying firms which are able to enrich the value proposal of the platform by developing niche activities.
Creating a technical platform with good connectors.	Architecture must be open to others actors with connectors and interfaces where firms will be able to construct their own platform.
	Intellectual property rights must be shared in order to reduce cost of connection to the platform for niche players.
Defining an innovation evolution way shared with niche players who will participate to the co-creation of the business ecosystem	Creating an identity and a collective intelligence shared with all business ecosystem members.
Allowing an evolution to the platform maintaining "vibrancy" of the business ecosystem	Innovation must be the business ecosystem core and the business ecosystem must be assured that platform stay useful for niche players to keep them into the business ecosystem.
	Making long term investments in order to coordinate niche players activities and create value for all ecosystem members

Table 3.1: Conditions to the development of an industrial platform

In order to show how architectural knowledge flows contribute to achieving these conditions, we use the Anderson et al (2008) model.

3.3 Understanding the role of architectural knowledge in the design phase of an inter-organisational innovation: the Anderson et al (2008) model

Inter-organisational innovation in the information and communications technology (ICT) sector is based on independent and existing technological systems or matching bases (connection) that constitute components of a larger architecture (Ulrich, 1995; Baldwin and Clark, 2000). This architecture is a set of components, acquired, applied, developed, and improved in the long term and implemented in a specific place in a product's systemwith the help of a core design concept (Henderson and Clark, 1990). A spell of exchanges and negotiations is necessary during an architectural innovation process in order to identify the dominant product or system architecture (West and Dedrick, 2000). These negotiations are oriented by specific knowledge, called architectural knowledge, stored in existing computerised structures and systems (Henderson and Clark, 1990). When innovation is resulting from an inter-organisational process, two or more components are interconnected. These are components able to separately provide a set of specific uses that provide value creation for the customer or the final user. These components are composed of a base system, knowledge (called "component knowledge"), and industrial relations, and they are bought on a specific market. Their interconnection is facilitated by a collective action from two or more firms that operate on different markets, and it needs an architecture design to promote a match between heterogeneous technologies that were initially independent components (Anderson et al, 2008). This collaborative innovation process is based on essential prerogatives: the development of channels and communication filters between actors and the instantiation of the four dimensions of heterogeneous actors of architectural knowledge. These four dimensions enable the study of the necessary conditions for the design process of an

inter-organisational innovation. They are indispensable to creating exchange places where heterogeneous actors meet each other and negotiate the matching of their technologies (Kellogg et al, 2006).

The first three dimensions are a subset of architectural knowledge:

- *Technology capability awareness*, which is the actors' awareness of the components technology capability. This awareness is made possible by previous experiences related to these components.

- *Use context sensitivity*, which is the understanding of the context in which a specific component is deployed. The sensitivity is the understanding that many innovation contexts exist and can be mobilised.

- *Business model understanding*, which is the evaluation of market opportunities related to the applications of a component.

The fourth dimension - *boundary-spanning competence* (relational competence) - is the ability to develop the first three dimensions (Anderson et al, 2008, p. 35). This fourth dimension represents the resources and competences used and engaged in a collective process where heterogeneous firms redefine their knowledge of components in order to associate them with other components (other firms' components) and to co-develop architectural knowledge. It depends on good relationships between firms and good inter-firm information exchanges (Van de Ven, 2005). The lack of *boundary-spanning know-how* can slow down their co-creation and inter-organisational innovation. If there is no leading actor (or it is not identified), the role of the relational dimension of architectural knowledge is essential. This dimension can take the form of a platform strategy with a neutral solution promoting the emergence of architectural knowledge. This role must be fulfilled by neutral actors, according to Anderson et al (2008), such as public institutions (universities, research

centres, industry associations).

We propose to apply the Anderson et al (2008) model to the case of an emergent digital business ecosystem with no pre-existing technological platform.

3.4 Methodology

Our analysis is based on a case study involving exploratory research. In fact, according to David (2000), mobilising one or more cases is interesting *when the questions asked are "how" or "why" about a set of contemporary events and on which the researcher has no control* (Yin, 2003, p. 20). In our case study, we analyse the design conception of a technological platform produced through an inter-organisational innovation from the *"Financial Inclusion based on upon Rural mobiquitous Services Technological platform"* (FIRST) project. This project is co-founded by the University of Nice Sophia Antipolis (Master MBDS, laboratories I3S and GREDEG-CNRS-UMR 7321) and Tata Consultancy Services (TCS), a service company in Information and Telecommunication (IT) engineering specialised in IT and software development. The empirical case is studied in order to question and test pre-existing theoretical notions used to validate them empirically.

3.4.1 Exploratory research based on a case study

The epistemological stance adopted is constructivist, allowing "the knowledge legitimisation built with interpretation and data management ... and with the mobilisation of existing knowledge - i.e. knowledge which its legitimisation is known by the researcher - under conditions of transparency, ethic and epistemic and empirical rigour" (Gavard-Perret et al, 2012, p. 34). We chose to collect our data by active

observation in line with David (2000) and Chanlat (2005). This method is pertinent when the researcher status is known in the observed organisation and, furthermore, because our data are collected without intervention in the studied phenomena (Savall and Zardet, 2004).

More precisely, our approach is characterised by several switches back and forth between theory and the case study in order to underline their complementarity and to add new elements to the theory. This stance was respected in all three research tasks: theoretical research, interviews with experts, and the case study. The two main theoretical axes of this research (technological platform strategy and architectural innovation theory) were built as the interviews were conducted. Data collection was performed in several stages and manners: observation, document analysis (secondary data: analysis of technical documents given by practitioners, activity reports, online information collection, etc.) and semi-structured interviews (primary data). We had participated in all the phases of FIRST's project definition and, during our participating observation in seven meetings, we collected primary data (about the proposed work bringing out the innovative approach planned to be tried, the proof of concept, the position of the proposal vis-à-vis existing and emerging scenario, scheduling and mechanism of interaction, the management of intellectual property, etc.). We were also included in e-mails exchanged between all FIRST partners since the conception of the project. Second, we gathered our primary information thanks to semi-structured interviews lasting about one and a half hours with practitioners (three interviews) and our participation in setting up the project's meetings and negotiations. The semi-structured interviews conducted with the project manager of the three directly implicated actors in FIRST platform deployment had the main objective of confirming and completing the subjects we had identified. Second, we completed our primary information thanks to semi-structured interviews lasting

about one-and-a-half hours with practitioners (three interviews) and our participation in setting up the project's meetings and negotiations.

The final subject analysis (Bardin, 2003) resulted in identification of eight themes (business ecosystem, business model, open innovation, platform strategy, alliance, architectural knowledge and innovation, co-design, digital territory) consolidated into two themes (technological platform and architectural innovation theory) used to analyse our primary and secondary data.

3.4.2 The case study: FIRST project

The goal of the FIRST project is to develop a generic system based on NFC technology in order to distribute a set of banking services via a medium accessible to the rural Indian population: the mobile phone. According to the Indian Ministry of Finance (2011), 47% of the Indian rural population (compared with 80% in urban zones) has at least one mobile phone per family. The FIRST project was created in 2010 and mobilises four actors: TCS, the Indian Institute of Science, Bangalore (IISc), the Master MBDS of UNS, and GEMALTO. It is supported the Indo-French Centre for the Promotion of Advanced Research (IFCPAR) financed by the Department of Science and Technology from the Government of India and the Ministry of Foreign Affairs from the Government of France.

More precisely, FIRST aims to deploy a generic platform that solves problems in the *Public Distribution System* (PDS), and then to move on to a set of virtual service offerings for the Indian rural populations who have no access to banking services. The PDS is a public aid system relating to the consumption of basic products (rice, wheat, kerosene, etc.) provided by the Indian Government, via private retail

outlets (*Fair Price Shops*) to enable poor people to access these products at a subsidised price. The Government buy a part of the national agricultural production, named Procurement, which it sells to the Central State in order to stabilise agricultural prices on the consumption market and to help the management of stocks of agricultural products and their distribution. The distribution of food products is made via private retails, the "Fair Price Shops" which sells them at a subsidised price. Households, classified in three categories, are concerned by this aid: households which earn more than the poverty line (APL: Above Poverty Line), households which earn less than the poverty line (BPL: Below Poverty Line) and the poorest (AAY) which buy food products at a heavily subsidised price. For example, households AAY and BPL have 35kg of food grains each month, and households APL have 15 to 35kg (Government of India, 2011). The innovation trajectory of FIRST has social and economic goals (*from financial inclusion to rural inclusion in India*, Debi Pati, Project Manager, TCS). Technologically, FIRST aims to ensure interoperability between two solutions based on different industrial infrastructures (banking infrastructure and telecoms infrastructure). This sectorial convergence raises many issues concerning the ecosystem actors' strategic positioning (Basole, 2009) and the business model of the services offered.

To enable the pilot to be deployed and offer services in India, the technology and business model will need to fully align with the regulatory framework in place in India. It will also seek to dovetail with the payment and interoperability infrastructure being established for mobile banking. The proposed FIRST project will seek to develop a sustainable business model involving the technology team, the banks, the mobile network operators (MNO's) and other intermediaries as may be required to reach out services to the poor and the disadvantaged. The sustainable model shall

be evolved keeping in view the existing and evolving regulatory regime, the economic imperatives, as also the priorities of inclusive growth. D. Pati, TCS.

The technological platform deployed by FIRST in July 2011 contains a virtual account to register platform users. These users can access their account via a NFC-compatible mobile phone (Smartphone) sold locally, a Bluetooth NFC sticker that makes every non-NFC mobile phone compatible with this technology, or with the help of an electronic card (the Indian Government can distribute these cards to benefit PDS users). This virtual account enables numerical identification of users and access to data about them (e.g., to know the food rights of users in the PDS).

The FIRST platform enables the dematerialisation of transactions between two groups of agents: a beneficiary of the PDS and a manager of a Fair Price Shop sustained by the PDS scheme. Both agents are, respectively, equipped with a Smartphone and a NFC tag reader, which is a sticker or wristband with small microchips that can be read by in-range mobile devices. Food products distributed via PDS are tagged with a NFC code. When a tag is read, a secure identification process enabling exchanges starts up (virtual coupons exchanged for food products). In the case of a banking service, the process will be the same: a dematerialised payment transaction starts up, aided by the user's Smartphone or NFC sticker when banks read the NFC tag.

This platform design requires a connection between technological solutions based on existing systems and characterised by extensive market penetration and by a technical architecture design that enables their connection. The next section analyses this design process, helped by our analysis grid proposed in our theoretical frame-

work.

3.5 The role of architectural knowledge in the FIRST platform design

We now demonstrate that the FIRST platform design is a supply-chain platform that will evolve into an industrial platform thanks to the actors' architectural knowledge.

3.5.1 FIRST, design of a supply-chain technological platform: the role of previous architectural knowledge

The objective of FIRST design is to combine two core components. Each component is provided by an actor in the project. The first component is Gemalto's Trusted Secure Manager Over The Air (TSM-OTA). This component makes the interface with telecommunication operators, providing the secure element of the FIRST solution. It also ensures the security of private data exchanges (user identification, rights management, etc.) between this secure element and TCS's financial TSM, this latter providing a secure interface between users and banks.

This architecture will be based upon two TSM's (Trusted Service manager) to be as open as possible with symmetric role expected by banks and Mobile Network Operators (MNO). These 2 functional TSMs' are "core" and "NFC business enablers". There are a financial TSM-FIRST open to any bank (operated by TCS) and a telecom TSM-OTA, provided by us, open to any MNO. F. Lemaire, Gemalto.

This architecture is composed of two core components developed and tested previously by two actors - Gemalto and TCS - bound by commercial relationships (customer-provider). The component of TCS, which is the leader in India, is based on its expertise in integration system development of software and in customer relationship management. Gemalto provided its TSM-OTA solution, legitimised by its global renown on the numerical transactions security market. The combination of these two components was made possible thanks to the generic architecture designed by UNS in the form of a standard (a set of norms) that describes system functioning rules, links, and possible interactions between components. In fact, the FIRST platform design development by UNS is based on its know-how in the development of NFC platforms supporting an offer of territorialised and dematerialised services (several projects have been implemented since 2009).

Given the projects developed by UNS in NFC platform, the idea was to capitalise on these developments, to generalise them in order to define a generic architecture suitable for FIRST and other services in the framework of FIRST or other service offers. B. Renaut, Project Manager, UNS.

By defining system functions, that is, interactions between its components, and by planning possible changes, UNS creates the core design concept of the FIRST platform, which creates an exchange area that enables TCS and Gemalto to interconnect their architectural knowledge as defined by Anderson et al (2008) and Jaspers et al (2012). The FIRST platform design is thus an architectural innovation with a *core design concept* (Henderson and Clark, 1990) deployed by UNS and with a known final product that connects Gemalto and TCS components.

Actor	Component
FIRST: A supply-chain platform	
TCS	• Solution Trusted Service Manager (TSM) for banks: Financial TSM • Virtual accounts for final users • Interfaces web, NFC
GEMALTO	• Solution TSM-OTA (Trusted Service Manager – Over The Air) that enables the interface with telecommunication operators (MNO[a]): Telecom TSM-OTA • SIM cards (secure element) and NFC stickers
UNS	• Technical architecture • NFC tags reader and interfaces web, NFC

[a]Mobile network operators.

Table 3.2: FIRST supply-chain platform's characteristics

According to these elements, the FIRST platform can be characterised here as a supply-chain platform (table (3.2)).

Boundary-spanning competence comes from UNS, which is a neutral actor because of its function as a public research institution (Anderson et al, 2008). However, this platform will evolve. In the event of success, the objective of the FIRST project is to develop a technological NFC platform to solve problems of low penetration of banking services in India. The next section studies the conditions that allow this evolution.

3.5.2 FIRST, from a supply-chain platform to an industrial platform: the role of each dimension of architectural knowledge

The openness of the FIRST supply-chain platform to the banking market requires some conditions identified by ecosystem actors and based on specific architectural knowledge. First, they identify the structuring element of the platform. The second objective of FIRST is to position itself as a solution to the problems of financial inclusion in India. In this regard, the secure financial element of TCS (financial TSM) is the central component of the FIRST platform. In fact, two dimensions of architectural knowledge acquired by TCS on its component give the FIRST ecosystem the possibility of opening its platform to banking services and commercial transactions ("technology capability awareness" dimension). This possibility of developing banking activities via the FIRST platform was revealed thanks to the "use context sensitivity" dimension of TCS. TCS analysed the particular context of India (problems of fraud and black market of the PDS, Reserve Bank of India, 2010, and financial inclusion issues in the country). To solve these problems, TCS wants to use the FIRST platform to develop secure banking services via mobile phones (bank account, credits, savings, and payments).

This solution would address the 10 features of Financial Inclusion program concern (cf. Jaipur Conference): cash deposit/withdrawal, immediate credit, saving product, remittance and payment services, life assets, mortgage, entrepreneurial credit, advisory services, enabling welfare payments to the poor under various welfare schemes, and pension for elderly and financial plan for children. In going forward, the solution landscape will be capable of supporting value added services envisioned in later

point time. D. Pati, TCS.

Potential niche activities and innovation trajectories shared with the other members of the FIRST ecosystem, which are essential conditions for an industrial platform design as defined by Iansiti and Levien (2004) and Gawer and Cusumano (2012), were identified by TCS from the outset thanks to two dimensions of architectural knowledge acquired on its financial component ("use context sensitivity" and "technology capability awareness" dimensions). TCS also wants to develop this platform in other emerging countries where the company already has branches.

In case of success, large dissemination in rural India and emerging countries (Morocco, Tunisia, Haiti, Vietnam, Nigeria, Russia, Brazil, ...) could be envisioned by TCS and other software house partners (already identified in these countries). D. Pati, TCS.

The evaluation of market opportunities by TCS (and by its architectural knowledge, "business model understanding") enables the FIRST platform to open and enrich its value proposition and to be deployed in markets other than the initial market for which the supply-chain platform has been designed. The role of UNS as assembler is no longer the element that creates value or the structuring element of the platform. The financial TSM is the structuring element of the platform. It becomes the core element in the industrial version of the FIRST platform that enables external firms to enrich the value proposition of the platform, and the role

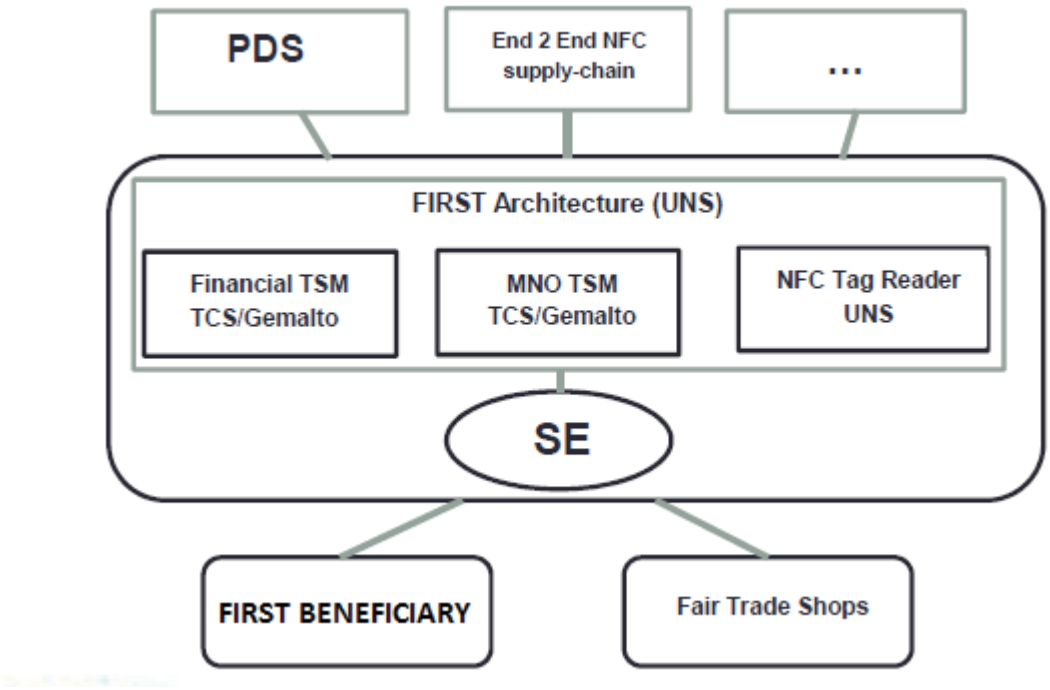

Figure 3.1: FIRST architecture and its evolution

of the assembler is less important than the value created by the TCS component. The interactions and strategic positioning of the FIRST ecosystem actors change. In its industrial form, TCS becomes the leading actor of the FIRST platform because it provides the structuring component. By connecting to the financial TSM, banking actors and other potential actors enrich the value proposition and position themselves as niche actors. The relation between niche actors also requires the TSM telecom from Gemalto, which maintains its commercial relationship with TCS and remains the TSM-OTA solution provider in the FIRST project (figure (3.1)).

3.5.3 FIRST key architectural knowledge and its mains flows and processes in the industrial technological platform design

As summarised in table (3.3), two dimensions of architectural knowledge have been identified here as key flows in the design process of the FIRST industrial technological platform: the "use context sensitivity" dimension of one or more members and the combination of component knowledge.

Conditions	*Means employed by FIRST's actors*	*Architectural knowledge mobilised*
Structuring element	The financial TSM (TCS)	TCS's technology capability awareness
	Banks and local service providers are identified by TCS as potential niche players	TCS's use context sensitivity
Designing a technological platform	The architecture developed by UNS is going to be put on open source in order to allow the connection of niche activities	TCS's use context sensitivity
	IPR of a component remain with its owner	Component knowledge of each actor
	Shared IPR are conclude only when foreground IP are jointly developed	
Defining an innovation trajectory	The FIRST platform is the back office support of a mobile services package that can be continuously enriched	TCS's business model understanding

Sources: Gawer & Cusumano (2012), Iansiti & Levien (2004).

Table 3.3: The role of architecturale knowledge as flows in designing a technological platform

With FIRST, the first role concerns architectural knowledge flows from TCS to other members of the ecosystem. The second is a combination of components provided by all the actors thanks to UNS's relational competences and its *boundary-spanning competence*. This combination is linked by the UNS generic platform. The role of UNS is not sufficient because the connection between the financial and the telecommunication TSM needs to share IP. However, with FIRST, the collaborative agreement between the three actors specifies that *all background IP of a party shall remain the sole and exclusive property of such party and that each party shall own the foreground IP which is developed or which arises as a result of that party performing its obligations pursuant ... For any joint Intellectual Property Right (IPR) made under this agreement, the parties (...) shall jointly own such IPR.*

As Gawer and Cusumano (2012) show in their research, sharing both background and foreground IPR is, however, a key flow in the design process of a technological platform. The first agreement concluded between FIRST actors (the exclusive IP of components provided by each actor) was clearly going to impact the evolution of the platform from supply chain to industrial. It was also going to highlight the complexity of the FIRST business model or, conversely, to structure it.

3.6 Concluding remarks

This research studied the essential conditions for an inter-organisational technological platform design. Contrary to what is often seen in the leadership and business ecosystem literature, it analyses the situation where the structuring element of an inter-organisational innovation is not provided and is co-constructed by actors of its ecosystem. As we show in the study of FIRST project, the inter-organisational design of a technological platform is based on architectural knowledge flow diffusion between the ecosystem's heterogeneous actors. This platform can take several forms. Its evolution requires identification of the structuring element, a component of the supply-chain platform, for example, which will structure the industrial platform. The innovation trajectory of the platform is defined by the leading actor and it must define a strategic vision shared by the members. These conditions are realised, as we can see with FIRST, thanks to architectural knowledge flows between actors. It is these knowledge flows that enable a technological platform to move up from supply-chain to industrial platform, contributing to the emergence of a digital business ecosystem. First designed as a supply-chain platform, FIRST evolves into an industrial platform thanks to architectural knowledge held and shared by TCS and to a generic platform deployed by UNS.

These results contribute to the platform strategy literature in two ways. They first show that in the new telecommunication ecosystem (Basole, 2009), the core element (the technological platform) of the business ecosystem could be designed in an inter-organisational way. This design process should be the main condition of innovative mobile services success, because it solves important coordination problems between stakeholders. More precisely, as we see in our case study, the FIRST platform is based on two components that are the property of two leaders in their industrial sectors: Gemalto and TCS. In order to make possible the interconnection between these two components, one dimension of architectural knowledge played a key role: UNS's "boundary-spanning competence". UNS's architectural knowledge resolves important coordination problems that characterise the new digital business ecosystem. Second, these results highlight that in a platform ecosystem, when the technological platform is of the industrial type, the role of a neutral actor and the role of architectural knowledge flows are two key conditions of any digital business ecosystem mergence. More precisely, in addition to the four conditions pointed out by the traditional platform strategy literature (Iansiti and Levien, 2004; Gawer and Cusumano, 2012), the "boundary-spanning competence" dimension of architectural knowledge is one more key condition of any industrial platform ecosystem emergence. Firms have to consider the key role of a neutral and public actor in the design of an inter-organisational platform, especially when the business ecosystem is not yet a leader (Anderson et al, 2008).

From a managerial point of view, the present research highlights three points. First, it shows that architectural knowledge represents key flows in the inter-organisational design process of a digital business ecosystem's technological platform. We can distinguish two phases. The "use context sensitivity" dimension of architectural knowl-

edge has a key role in only the birth phase of the business ecosystem (the co-design phase of the business ecosystem's core element). The main success condition of this first phase is the key role played by a neutral actor's (a public research institute, for example) "boundary-spanning competence" dimension of architectural knowledge, as discussed earlier. In the expansion phase of the business ecosystem, two dimensions of architectural knowledge acquired on FIRST's financial component ("business model understanding" and "technology capability awareness" dimensions) meet two main conditions allowing the emergence of any industrial platform (defining an innovation trajectory shared with niche players andmaintaining the "vibrancy" of the business ecosystem). We believe that these two architectural knowledge flows should position their owner as the leader in the expansion phase of the business ecosystem.

Second, the present research pointed out the main role of IPR. The FIRST platform will successfully evolve into an industrial platform if the share of IPR is not limited to foreground IPR but includes background IPR. Third, it also points out that a digital business ecosystem may emerge if both background and foreground IPR are shared. In conclusion, knowledge flows can be shared in a collective innovation context; however, in a commercial and industrial phase these flows can be slowed down, notably because of IPR. Sharing both background and foreground IPR is, however, a key flow in the design process of a digital business ecosystem's technological platform. Conversely, licensing the use of partners' background IP and foreground IP may facilitate the elaboration of the platform's business model. It will therefore be interesting to analyse in future research how not sharing the IPR of an inter-organisational platform will not hinder the emergence of a digital business ecosystem but rather contribute to enhancing crucial sources of value creation for its business model.

Conclusion générale

Cette thèse s'est intéressée aux questions de la mise en place et de développement des monnaies mobiles sociales. Elle s'est plus particulièrement concentrée sur les conditions d'émergence, de viabilité, et d'efficacité de ces systèmes, nécessaires à l'aboutissement des objectifs sociaux qui sous-tendent à leur création. Cette thèse s'est employée à répondre à ces interrogations par le biais de diverses méthodes, tant empiriques que théoriques.

Synthèse et discussion

Le premier chapitre de cette thèse a proposé une approche théorique de la circulation d'une monnaie complémentaire au sein d'un Système d'Echange Local (SEL). Ce SEL, en plus de favoriser les échanges au sein du secteur informel via l'octroi d'un crédit mutuel, permet aussi à ses membres de maintenir leurs compétences et leur employabilité en participant à une activité productive rémunérée en monnaie mobile complémentaire. Le niveau de confiance préalable des agents vis-à-vis du SEL, relatif à leur utilité espérée retirée de leur participation à un SEL, apparaît comme crucial dans l'émergence et la viabilité de ce système. En effet, seul un niveau de confiance suffisamment élevé des agents envers la fiabilité de la monnaie complémentaire échangée permettra au système d'émerger. Ce niveau de confiance peut être amélioré de différentes manières. Par les objectifs sociaux qu'ils support-

ent (retour à l'emploi et inclusion sociale), les SEL peuvent être encouragés par les collectivités locales, tant au niveau organisationnel que financier. Ces collectivités joueraient alors un rôle d' un organisme incitatif encourageant les membres potentiels du SEL à franchir le pas. De plus, l'organisation privée qui met en place le SEL doit assurer son bon fonctionnement (assurer la mise en relation des membres pour favoriser les échanges) afin de veiller à la bonne réputation de son système. Ces deux recommandations vont dans le sens du rapport remis à Carole Delga, Secrétaire d'État chargée du commerce, de l'artisanat, de la consommation et de l'économie sociale et solidaire le 8 avril 2015. Le crédit mutuel accordé aux membres des SEL apparaît comme un moteur clef des échanges. Cependant, il peut aussi avoir un effet négatif sur les buts poursuivis par ces communautés organisées autour de monnaies complémentaires. En effet, distribué à un niveau trop important, il peut décourager les membres à produire, alors que l'activité productive est nécessaire au maintien de leurs compétences et de leur employabilité. La circulation d'une monnaie complémentaire au sein d'un SEL a une influence positive sur le niveau d'emploi et le bien-être des agents, conditionnée au niveau de crédit accordé aux membres de ces systèmes. Les SEL facilitent donc le retour à l'emploi des individus qui y participent en évitant la déterioration des compétences subies par les travailleurs durant les périodes de chômage, mais aussi en favorisant l'auto-entreprenariat. Les membres des SEL peuvent ainsi tester leur activité au sein du SEL et par la suite développer cette activité productive en créant leur propre entreprise.

Ce travail pourrait être poursuivi par deux approfondissements théoriques. Le premier consiterait à étudier la réallocation des activités économiques résultant de l'existence de systèmes d'échanges locaux. En effet, participer à ces systèmes permet aux membres d'accroître leur pouvoir d'achat et d'accéder au sein du SEL à des biens et des services de première nécessité, en offrant à leur tour la production de ce

type de biens/services. Il s'agirait alors de comprendre comment le réorientation de cette consommation interne au SEL évince la consommation de ces mêmes types de biens produits par le secteur formel. Les revenus engendrés par le SEL peuvent en revanche accroître la consommation de biens technologiques produits par le secteur formel. Ces réallocations devraient être l'objet d'un approfondissement sur les plans théorique et empirique. Une deuxième analyse pourrait faire intervenir cette fois des entreprises dans le système d'échanges local. Cette présence des entreprises est conforme au fonctionnement des monnaies complémentaires qui circulent au sein d'une ville. Les entreprises acceptant ces monnaies complémentaires sont tenues à des exigences sociales et environnementales pour la production et la distribution de leurs biens/services. De plus, ces systèmes de monnaies complémentaires octroient des avantages financiers à leurs utilisateurs (conversion avantageuse de la monnaie nationale en monnaie complémentaire, réductions dans les commerces du réseau) pour inciter leurs membres à participer et à consommer dans les commerces partenaires. Ainsi, ces systèmes modifient les règles de la concurrence en orientant une partie des consommateurs vers certains détaillants. Il s'agirait alors d'évaluer la réaction des entreprises nouvellement concurrencées et d'étudier leur réponse à la menace issue de l'émergence des monnaies complémentaires.

Le deuxième chapitre de cette thèse s'est intéressé aux conditions de mise en place et d'adoption de la monnaie mobile dans les pays émergents et en développement. En effet, si l'objectif qui sous-tend au développement d'une monnaie mobile dans ces pays est l'inclusion financière d'une population faiblement ou non-bancarisée, il apparaît que la disponibilité des infrastructures bancaires et la connaissance préalable des services financiers jouent un rôle majeur dans leur déploiement. Les fournisseurs de monnaie mobile sont encore dépendants des infrastructures et du réseau de distribution bancaires pour gérer les liquidités des utilisateurs. De plus, une connais-

sance préalable des services financiers apparaît comme un déterminant favorisant l'adoption de la monnaie mobile et influence donc la décision des fournisseurs de déployer un tel service. Cette dépendance des fournisseurs de monnaie mobile au système bancaire existant dans le pays ciblé, à la fois pour la mise en place et l'adoption de leurs services, conduit à une double exclusion des pays faiblement bancarisés. Ceux-ci doivent en effet disposer d'un système bancaire suffisamment inclusif pour bénéficier des innovations financières, telles que la monnaie mobile, mais aussi pour permettre leur adoption et donc leur efficience (inclure financièrement les personnes peu ou non bancarisées). Les licences accordées aux fournisseurs de monnaie mobile dans certains pays permettent à des acteurs non bancaires de proposer ces alternatives. Cependant, les réglementations en vigueur, aussi souples soient-elles, ne leur permet de recevoir des dépôts, les montants reçus étant plafonnés. Les salaires des utilisateurs ne donc peuvent pas être versés sur un compte de monnaie mobile. Les fournisseurs de monnaie mobile doivent alors s'assurer de développer et d'étendre l'acceptation de leurs services auprès des commerçants afin de limiter le recours aux espèces par les utilisateurs. D'un autre côté, afin de garantir l'adoption de leur alternative financière, les fournisseurs de monnaie mobile doivent déployer un important réseau d'agents, en charge de gérer les comptes des utilisateurs, afin que ceux-ci agissent aussi en tant qu'informateur et éducateur auprès de la population, la sensibilisant ainsi aux opportunités financières disponibles.

Cette analyse macroéconomique a permis de mettre en exergue la difficile adéquation entre les objectifs de la monnaie mobile mise en place dans les pays émergents et en développement et les conditions nécessaires à son déploiement et à son adoption. Cependant, elle a été réalisée sur la période 2004-2012, correspondant à la période d'émergence de la monnaie mobile. Durant cette période, de nombreux pays n'avaient pas encore bénéficié d'une réglementation permettant aux acteurs

non bancaires de mettre en place des systèmes de monnaie mobile. De même, ce nouveau moyen de paiement n'avait pas encore atteint son potentiel maximum en termes d'uilisateurs. Le secteur de la monnaie mobile est en constante évolution, permettant une amélioration rapide et significative de ces services. Les fournisseurs de monnaie mobile concluent de plus en plus d'alliances avec d'autres fournisseurs et/ou des établissements bancaires afin d'accroître l'interopérabilité de leur monnaie mobile et de proposer un panel toujours plus large de services financiers. Ainsi, une nouvelle étude pourra être envisagée, lorsque des données plus récentes seront disponibles, afin d'identifier à nouveau le potentiel de la monnaie mobile comme instrument d'inclusion financière, une fois ces services arrivés à maturité. De plus, elle pourra être complétée par une analyse conduite sur des données d'usage des services financiers mobiles en Inde, terrain du projet FIRST, afin d'identifier le profil des utilisateurs de ces services et de comprendre comment cette monnaie peut répondre aux problèmes d'inclusion financière existants.

Le troisième chapitre de cette thèse s'est interrogé sur les conditions essentielles à la conception d'une plateforme technologique. Il s'est consacré au cas particulier où l'élément structurant d'une innovation inter-organisationnelle fait l'objet d'une co-conception entre les acteurs de son écosystème et n'émane pas, comme c'est le cas dans la majorité des cas étudiés par la littérature, d'une firme qui en serait détentrice. Dans le cas FIRST, la conception inter-organisationnelle d'une plateforme technologique repose sur la mise en relation et l'échange des connaissances architecturales propres aux acteurs de l'écosystème. Cette plateforme peut prendre plusieurs formes et connaître différentes évolutions. Elle peut dans un premier temps être de type supply-chain puis évoluer et se positionner comme plateforme industrielle. Pour cela une des composantes de la plateforme supply-chain doit être identifiée comme étant l'élément structurant de la plateforme dans sa forme indus-

trielle. De même, la trajectoire d'innovation de cette dernière doit être définie par ses acteurs. Elle reflète la vision stratégique partagée par les acteurs qui cherchent à en enrichir la proposition de valeur. Les connaissances architecturales jouent un rôle clef dans l'élaboration de la plateforme. En effet, c'est bien à travers elles que le passage d'une plateforme de type supply-chain à une plateforme de type industriel peut être facilité. D'abord favorisée par les connaissances architecturales de type relationnel de l'Université Nice Sophia Antipolis, FIRST prend la forme de plateforme supply-chain et évolue ensuite vers la forme industrielle grâce aux trois sous composantes d'une connaissance architecturale : celle détenue par Tata Consultancy Services.

Cette étude pourra être poursuivie par une analyse du positionnement stratégique des acteurs et de la manière dont les stratégies coopétitives qui caractérisent un écosystème peuvent impacter la conception et l'évolution de la plateforme technologique. Il s'agirait de mettre l'accent sur la question suivante : comment le partage et/ou l'ouverture des droits de propriété intellectuelle propre aux composantes d'une plateforme supply chain participent ou peuvent freiner son évolution vers sa forme industrielle? Cette interrogation est d'autant plus pertinente que, dans le cas de FIRST par exemple, l'architecture de la plateforme est susceptible d'être mise sous licence open source par son développeur (l'Université Nice Sophia Antipolis). La mise en place du pilote du projet FIRST est programmée pour le début de l'année 2016 en Inde. Ce déploiement permettra de suivre l'évolution du projet et du positionnement des acteurs dans le développement d'une plateforme industrielle. Enfin, des comparaisons entre le déploiement de la plateforme FIRST et d'autres plateformes en émergence pourront être envisagées afin de généraliser ces premiers résultats.

Appendix I

The benchmark model

Derivation of e, s, and l:

$$\begin{cases} \alpha' s + \alpha l = qe \\ (1-\alpha')s = \alpha l \\ e + s + l = 1 \\ e = \frac{\alpha}{\alpha+q-\alpha' q+\alpha q} \\ l = \frac{q(1-\alpha')}{\alpha+q-\alpha' q+\alpha q} \\ s = \frac{\alpha q}{\alpha+q-\alpha' q+\alpha q} \end{cases}$$

Derivation of V_e, V_s, and V_l:

$$\begin{cases} x = (1-q)\frac{1}{1+r}w + qb\frac{1}{1+r} + (1-q)\frac{1}{1+r}x + q\frac{1}{1+r}y \\ y = \alpha' w\frac{1}{1+r} + (1-\alpha')b\frac{1}{1+r} + \alpha'\frac{1}{1+r}x + (1-\alpha')\frac{1}{1+r}t \\ t = \alpha w\frac{1}{1+r} + (1-\alpha)\frac{1}{1+r}b + \alpha\frac{1}{1+r}x + (1-\alpha)\frac{1}{1+r}t \end{cases}$$

with $x = V_e$, $y = V_s$, $t = V_l$

$$x = \frac{bg((-1+\alpha' g-\alpha g)q+g(-1+g-\alpha g+(-1+g)(-1+\alpha' g-\alpha g)q)w)}{(-1+g)(1+g(-1+\alpha+q-\alpha' gq+\alpha gq))}$$
$$y = \frac{bg(-1+\alpha'+g-\alpha' g+g(-1+\alpha' g-\alpha g)q)+g(\alpha'(-1+g)-\alpha g)w)}{(-1+g)(1+g(-1+\alpha+q-\alpha' gq+\alpha gq))}$$
$$t = \frac{bg(-1+\alpha+g-\alpha g+g(-1+\alpha' g-\alpha g)q)-\alpha gw)}{(-1+g)(1+g(-1+\alpha+q-\alpha' gq+\alpha gq))}$$
$$g = \frac{1}{1+r}$$

The comparative static analysis is made after expressing the derivatives of $x = V_e$ according to q, α and α'.

$$\frac{\partial x}{\partial q} = \frac{g(b-w)((\alpha-1)g+1)(\alpha' g-\alpha g-1)}{(g-1)(g(-\alpha' gq+\alpha gq+\alpha+q-1)+1)^2}$$
$$\frac{\partial x}{\partial \alpha'} = \frac{g^2(1+(-1+\alpha)g)q(b-w)}{(-1+g)(1+g(-1+\alpha+q-\alpha' gq+\alpha gq))^2}$$
$$\frac{\partial x}{\partial \alpha} = -\frac{(\alpha'-1)g^3q(b-w)}{(g-1)(g(-\alpha' gq+\alpha gq+\alpha+q-1)+1)^2}$$

Given the definition values of parameters, the first term is always negative, while the other ones are still positive.

The LETS model

Expression of t^* $t^* = (1/\bar{\lambda})(-(((1+r)^2(q+r)(b-w)(-1+\alpha^{'})(a^{'''}(\alpha-\alpha^{'})+C^2\gamma)-a^{''}C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha^{'}))(q(1+r+\alpha-a^{'''}\alpha+(-1+a^{'''})\alpha^{'}-C^2\gamma)+(1+r)(r+\alpha-a^{'''}\alpha+a^{'''}\alpha^{'}-C^2\gamma))+c((1+r)(r+\alpha)+q(1+r+\alpha-\alpha^{'}))(q(1+r+\alpha-a^{'''}\alpha+(-1+a^{'''})\alpha^{'}-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha^{'}+a_e(\alpha-a^{'''}\alpha+a^{'''}\alpha^{'}-C^2\gamma))))/(b^{'}((1+r)(r+\alpha)+q(1+r+\alpha-\alpha^{'}))(q(1+r+\alpha-a^{'''}\alpha+(-1+a^{'''})\alpha^{'}-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha^{'}+a_e(\alpha-a^{'''}\alpha+a^{'''}\alpha^{'}-C^2\gamma)))))+\bar{\lambda})$ for the non-negative values of the different populations of employed and unemployed workers, inside and outside the LETS.

Expression of e_l:

$e_l = -((1/\bar{\lambda}\alpha(-(((1+r)^2(q+r)(b-w)(-1+\alpha'))(a'''(\alpha-\alpha')+C^2\gamma)-a''C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+\alpha-a'''\alpha+$

$$a'''\alpha'-C^2\gamma))+c((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+$$
$$(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))))/(b'((1+r)(r+\alpha)+q(1+r+\alpha-$$
$$\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+$$
$$a'''\alpha'-C^2\gamma)))))+\bar{\lambda})-1/\bar{\lambda}C^2\gamma(-(((1+r)^2(q+r)(b-w)(-1+\alpha')(a'''(\alpha-\alpha')+C^2\gamma)-$$
$$a''C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+$$
$$\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))+c((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')$$
$$alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))))/(b'((1+r)(r+\alpha)+$$
$$q(1+r+-\alpha)(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-$$
$$a'''\alpha+a'''\alpha'-C^2\gamma)))))+\bar{\lambda})-1/\bar{\lambda}^2\alpha(-(((1+r)^2(q+r)(b-w)(-1+\alpha')(a'''(\alpha-\alpha')+$$
$$C^2\gamma)-a''C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+$$
$$r)(r+\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))+c((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+$$
$$a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))))/(b'((1+r)(r+\alpha)+$$
$$q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-$$
$$a'''\alpha+a'''\alpha'-C^2\gamma)))))+\bar{\lambda})^2+1/\bar{\lambda}^2\alpha'(-(((1+r)^2(q+r)(b-w)(-1+\alpha')(a'''(\alpha-\alpha')+$$
$$C^2\gamma)-a''C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+$$
$$r)(r+\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))+c((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+$$
$$a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))))/(b'((1+r)(r+\alpha)+$$
$$q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-$$
$$a'''\alpha+a'''\alpha'-C^2\gamma)))))+\bar{\lambda})^2)/(-q-\alpha\ -q\alpha+q\alpha'+C^2\gamma+C^2q\gamma+1/\bar{\lambda}\alpha(-(((1+r)^2(q+$$
$$r)(b-w)(-1+\alpha')(a'''(\alpha-\alpha')+C^2\gamma)-a''C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-$$
$$a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))+c((1+r)(r+\alpha)+q(1+r+$$
$$\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+$$
$$a'''\alpha'-C^2\gamma))))/(b'((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-$$
$$C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma)))))+\bar{\lambda})+1/\bar{\lambda}q\alpha(-(((1+$$
$$r)^2(q+r)(b-w)(-1+\alpha')(a'''(\alpha-\alpha')+C^2\gamma)-a''C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+$$
$$r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))+c((1+r)(r+$$
$$\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+$$

$$a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))))/(b'((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma)))))+\bar{\lambda})-1/\bar{\lambda}\alpha'(-(((1+r)^2(q+r)(b-w)(-1+\alpha')(a'''(\alpha-\alpha')+C^2\gamma)-a''C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))+c((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma]))))/(b'((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma)))))+\bar{\lambda})-1/\bar{\lambda}q\alpha'(-(((1+r)^2(q+r)(b-w)(-1+\alpha')(a'''(\alpha-\alpha')+C^2\gamma)-a''C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))+c((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))))/(b'((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma)))))+\bar{\lambda})))$$

Appendix II

Mobile Money services' first implementation

Country	Name of the first Mobile Money service launched	Date of implementation	Name of the service provider	Type of service provider
Afghanistan	M-PAISA	2008	Roshan	MNO
Benin	MTN Mobile Money	2010	MTN	MNO
Burkina Faso	Inovapay	2009	Inova SA	Electronic payment solutions provider
Burundi	EcoKash	2010	Econet Wireless	MNO
Colombia	Transfer Aval	2012	Claro	MNO
Rep. Dem. of Congo	M-PESA	2012	Vodacom	MNO
Côte d'Ivoire	Orange Money	2008	Orange	MNO
Fiji	M-PAISA	2010	Vodafone	MNO
Guinea-Bissau	MTN Mobile Money	2010	MTN	MNO
Indonesia	T-cash	2007	Telkomsel	MNO
Kenya	M-PESA	2007	Vodafone	MNO

Country	**Name of the first Mobile Money service launched**	**Date of implementation**	**Name of the service provider**	**Type of service provider**
Lesotho	Ecocash	2012	Econet Wireless	MNO
Liberia	Mobile Money	2011	Lonestar	MNO
Madagascar	Orange Money	2010	Orange	MNO
Malawi	Airtel Money	2012	Airtel	MNO
Malaysia	M-Money	2007	Maxis Communications	MNO
Mali	Orange Money	2010	Orange	MNO
Mongolia	MobiXpress	2010	MobiCom	MNO
Morocco	MobiCash	2010	Maroc Telecom	MNO
Namibia	Mobipay	2010	Mobipay	Electronic payment solutions provider
Nicaragua	mPeso	2010	mPeso	Electronic payment solutions provider
Niger	Orange Money	2010	Orange	MNO
Nigeria	PocketMoni	2003	Etranzact	Electronic payment solutions provider
Papua New Guinea	Cellmoni	2011	Digicel	
Paraguay	Tigo Money	2010	Millicom	MNO
Philippines	GCASH	2004	Globe Telecom	MNO
Rwanda	MTN Mobile Money	2010	MTN	MNO
Samoa	Digicel Mobile Money	2011	Digicel	MNO

Country	**Name of the first Mobile Money service launched**	**Date of implementation**	**Name of the service provider**	**Type of service provider**
Senegal	Wari	2008	Cellular Systems International	Electronic payment solutions provider
Sierra Leone	Splash Mobile Money	2009	Splash Cash	Electronic payment solutions provider
Somalia	SAHAL service	2009	Golis Telecom	MNO
Swaziland	MTN Mobile Money	2011	MTN	MNO
Tanzania	M-PESA	2008	Vodacom	MNO
Thailand	Mpay	2004	Advanced Info Service	MNO
Tonga	Digicel Mobile Money	2011	Digicel	MNO
Turkey	Turkcell Cuzdan	2012	Turkcell	MNO
Uganda	MTN Mobile Money	2009	MTN	MNO
Vanuatu	Digicel Mobile Money	2011	Digicel	MNO
Zambia	Zoona	2009	Zoona	Electronic payment solutions provider
Zimbabwe	Ecocash	2011	Econet Wireless	MNO

Source: GSMA Mobile Money Deployment Tracker

Correlations

Low income countries sample								
	BANKACCESS	BANKAVAIL	BANKUSE	URBAN	LABOURFORCE	MOBPEN	EDUC	REGUL
BANKACCESS	1.000							
BANKUSE	0.2969	1.000						
BANKAVAIL	0.6240	0.2738	1.000					
URBAN	-0.1761	0.1988	0.0166	1.000				
LABOURFORCE	-0.1952	0.0201	0.0736	0.1892	1.000			
MOBPEN	0.4411	0.3108	0.3438	-0.1414	-0.0854	1.000		
EDUC	0.5088	0.0337	0.1556	-0.6759	-0.3133	0.6009	1.000	
REGUL	0.0450	0.2171	0.0961	0.2919	0.2538	0.2692	-0.0377	1.000

Figure 2: Correlations between probit variables in low income countries sample

Middle income countries sample								
	BANKACCESS	BANKAVAIL	BANKUSE	URBAN	LABOURFORCE	MOBPEN	EDUC	REGUL
BANKACCESS	1.000							
BANKUSE	0.3712	1.000						
BANKAVAIL	0.5297	0.5227	1.000					
URBAN	-0.1868	-0.1200	0.1349	1.000				
LABOURFORCE	-0.2710	-0.2760	-0.0816	0.5140	1.000			
MOBPEN	0.5639	0.1809	0.2452	-0.3767	-0.1411	1.000		
EDUC	0.4383	0.1786	0.0471	-0.5028	-0.1969	0.4984	1.000	
REGUL	0.6583	0.3538	0.3700	-0.2328	-0.0376	0.3816	0.2919	1.000

Figure 3: Correlations between probit variables in middle income countries sample

Whole sample								
	BANKACCESS	BANKAVAIL	BANKUSE	URBAN	LABOURFORCE	MOBPEN	EDUC	REGUL
BANKACCESS	1.000							
BANKUSE	0.6636	1.000						
BANKAVAIL	0.7132	0.6359	1.000					
URBAN	-0.5697	-0.5086	-0.3944	1.000				
LABOURFORCE	-0.5659	-0.3814	-0.3785	0.5544	1.000			
MOBPEN	0.6693	0.5667	0.5510	-0.5300	-0.3800	1.000		
EDUC	0.6758	0.6403	0.5612	-0.6394	-0.5511	0.6337	1.000	
REGUL	0.6592	0.6745	0.5983	-0.4255	-0.2728	0.6157	0.5973	1.000

Figure 4: Correlations between probit variables in the whole sample

Analysis of multicollinearity: Variance Inflation Factor (VIF)

Low income countries sample sample : variance inflation factor (VIF)			Low income countries sample sample : variance inflation factor (VIF)			Low income countries sample sample : variance inflation factor (VIF)	
AVAILABILITY	1.23		ACCESSIBILITY	1.45		USAGE	1.17
URBAN	2.37		URBAN	2.79		URBAN	1.97
LABOURFORCE	1.40		LABOURFORCE	1.72		LABOURFORCE	1.20
EDUC	3.50		EDUC	4.59		EDUC	2.89
MOBPEN	1.89		MOBPEN	1.97		MOBPEN	1.83
REGUL	1.30		REGUL	1.34		REGUL	1.14
Mean VIF	1.95		Mean VIF	2.31		Mean VIF	1.70

Figure 5: VIF in low income countries sample

Middle income countries sample sample : variance inflation factor (VIF)			Middle income countries sample sample : variance inflation factor (VIF)			Middle income countries sample sample : variance inflation factor (VIF)	
AVAILABILITY	1.30		ACCESSIBILITY	2.54		USAGE	1.44
URBAN	1.86		URBAN	1.79		URBAN	2.12
LABOURFORCE	1.52		LABOURFORCE	1.62		LABOURFORCE	1.47
EDUC	1.59		EDUC	1.62		EDUC	1.56
MOBPEN	1.61		MOBPEN	1.70		MOBPEN	1.77
REGUL	1.44		REGUL	1.86		REGUL	1.45
Mean VIF	1.55		Mean VIF	1.86		Mean VIF	1.64

Figure 6: VIF in middle income countries sample

Whole sample : variance inflation factor (VIF)			Whole sample : variance inflation factor (VIF)			Whole sample : variance inflation factor (VIF)	
AVAILABILITY	1.49		ACCESSIBILITY	2.61		USAGE	1.61
URBAN	2.81		URBAN	2.71		URBAN	2.53
LABOURFORCE	1.69		LABOURFORCE	2.02		LABOURFORCE	1.70
EDUC	3.24		EDUC	3.10		EDUC	3.17
MOBPEN	2.43		MOBPEN	2.30		MOBPEN	2.69
REGUL	2.14		REGUL	2.26		REGUL	2.00
Mean VIF	2.30		Mean VIF	2.50		Mean VIF	2.28

Figure 7: VIF in the whole sample

Mean t-tests between countries with a MMU and the others

Mean t-tests on the whole sample, with 1 as MMU countries and 0 as non MMU countries

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	351	22.45448	1.29739	24.30659	19.90282	25.00614
1	324	6.978062	.6670974	12.00775	5.665658	8.290467
combined	675	15.0258	.8034846	20.87514	13.44816	16.60343
diff		15.47642	1.494802		12.54138	18.41145

diff = mean(0) - mean(1) t = 10.3535
Ho: diff = 0 degrees of freedom = 673

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

Figure 8: Mean t-test on ATM per 1000 km sq

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	369	12.15718	.8631754	16.58106	10.4598	13.85455
1	324	3.66906	.2584965	4.652937	3.16051	4.177609
combined	693	8.188707	.501475	13.20128	7.204112	9.173302
diff		8.488118	.9525563		6.617866	10.35837

diff = mean(0) - mean(1) t = 8.9109
Ho: diff = 0 degrees of freedom = 691

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

Figure 9: Mean t-test on bank branches per 1000 km sq

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	279	904.3437	42.70475	713.31	820.278	988.4095
1	279	516.9929	33.93212	566.7782	450.1963	583.7894
combined	558	710.6683	28.45662	672.2029	654.7729	766.5637
diff		387.3508	54.54434		280.2127	494.489

diff = mean(0) - mean(1) t = 7.1016
Ho: diff = 0 degrees of freedom = 556

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

Figure 10: Mean t-test on bank accounts per 1000 adults

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	378	41.43543	1.583055	30.7781	38.32271	44.54815
1	351	31.50322	1.283447	24.04536	28.97898	34.02746
combined	729	36.65325	1.0431	28.16371	34.60541	38.7011
diff		9.932211	2.056335		5.895147	13.96928

diff = mean(0) - mean(1) t = 4.8301
Ho: diff = 0 degrees of freedom = 727

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

Figure 11: Mean t-test on deposits to GDP (%)

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	387	35.99637	1.024605	20.15635	33.98187	38.01088
1	351	27.38518	1.226002	22.96914	24.97393	29.79644
combined	738	31.90081	.8080329	21.95115	30.31449	33.48713
diff		8.61119	1.587673		5.494284	11.7281

diff = mean(0) - mean(1) t = 5.4238
Ho: diff = 0 degrees of freedom = 736

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

Figure 12: Mean t-test on credits to GDP (%)

Mean t-tests on middle income countries, with 1 as MMU countries and 0 as non MMU countries

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	189	20.82061	1.749375	24.04993	17.36968	24.27154
1	153	13.27435	1.219746	15.08742	10.8645	15.68419
combined	342	17.44465	1.12711	20.84391	15.22769	19.66162
diff		7.546263	2.23295		3.154127	11.9384

diff = mean(0) - mean(1) t = 3.3795
Ho: diff = 0 degrees of freedom = 340

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9996 Pr(|T| > |t|) = 0.0008 Pr(T > t) = 0.0004

Figure 13: Mean t-test on ATM per 1000 km sq

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	189	14.22671	1.490963	20.49736	11.28554	17.16787
1	153	6.114385	.4432992	5.483308	5.238561	6.990208
combined	342	10.59751	.8741785	16.16639	8.878049	12.31697
diff		8.112321	1.704856		4.758928	11.46572

diff = mean(0) - mean(1) t = 4.7584
Ho: diff = 0 degrees of freedom = 340

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

Figure 14: Mean t-test on bank branches per 1000 km sq

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	135	1068.64	51.37202	596.8889	967.0354	1170.245
1	144	849.3559	51.6371	619.6452	747.2852	951.4265
combined	279	955.4613	36.96783	617.4845	882.6888	1028.234
diff		219.2844	72.92693		75.72303	362.8458

diff = mean(0) - mean(1) t = 3.0069
Ho: diff = 0 degrees of freedom = 277

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9986 Pr(|T| > |t|) = 0.0029 Pr(T > t) = 0.0014

Figure 15: Mean t-test on bank acounts per 1000 adults

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	189	46.65721	2.837191	39.00493	41.06039	52.25403
1	162	47.32422	2.111576	26.87598	43.15426	51.49418
combined	351	46.96506	1.809738	33.90543	43.40573	50.52439
diff		-.667009	3.635254		-7.816771	6.482753

diff = mean(0) - mean(1) t = -0.1835
Ho: diff = 0 degrees of freedom = 349

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.4273 Pr(|T| > |t|) = 0.8545 Pr(T > t) = 0.5727

Figure 16: Mean t-test on deposits to GDP (%)

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	189	39.15939	1.361613	18.71908	36.47339	41.84539
1	162	43.34536	1.97249	25.10569	39.45007	47.24065
combined	351	41.09138	1.172477	21.96634	38.78539	43.39736
diff		-4.185973	2.344606		-8.797309	.4253627

diff = mean(0) - mean(1) t = -1.7854
Ho: diff = 0 degrees of freedom = 349

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0375 Pr(|T| > |t|) = 0.0751 Pr(T > t) = 0.9625

Figure 17: Mean t-test on credits to GDP (%)

Mean t-tests on low income countries, with 1 as MMU countries and 0 as non MMU countries

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	63	1.577905	.2072415	1.644929	1.163635	1.992175
1	171	1.344542	.1284904	1.68023	1.0909	1.598185
combined	234	1.407371	.1092042	1.670504	1.192217	1.622525
diff		.2333627	.2462533		-.2518159	.7185413

diff = mean(0) - mean(1) t = 0.9477
Ho: diff = 0 degrees of freedom = 232

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.8279 Pr(|T| > |t|) = 0.3443 Pr(T > t) = 0.1721

Figure 18: Mean t-test on ATM per 1000 km sq

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	81	1.854214	.177681	1.599129	1.500617	2.20781
1	171	1.481137	.1539863	2.013633	1.177166	1.785109
combined	252	1.601055	.1193858	1.895191	1.365929	1.83618
diff		.3730764	.2550522		-.1292484	.8754013

diff = mean(0) - mean(1) t = 1.4627
Ho: diff = 0 degrees of freedom = 250

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9276 Pr(|T| > |t|) = 0.1448 Pr(T > t) = 0.0724

Figure 19: Mean t-test on bank branches per 1000 km sq

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	72	187.883	18.53236	157.2523	150.9306	224.8355
1	135	162.4723	9.176427	106.6204	144.323	180.6217
combined	207	171.3108	8.809499	126.7466	153.9425	188.6792
diff		25.4107	18.45638		-10.97796	61.79935

diff = mean(0) - mean(1) t = 1.3768
Ho: diff = 0 degrees of freedom = 205

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9150 Pr(|T| > |t|) = 0.1701 Pr(T > t) = 0.0850

Figure 20: Mean t-test on bank accounts per 1000 adults

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	81	23.7162	1.309287	11.78358	21.11063	26.32176
1	189	17.94236	.5503928	7.56665	16.85662	19.0281
combined	270	19.67451	.5719862	9.398692	18.54837	20.80065
diff		5.773838	1.199735		3.411733	8.135942

diff = mean(0) - mean(1) t = 4.8126
Ho: diff = 0 degrees of freedom = 268

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 1.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 0.0000

Figure 21: Mean t-test on deposits to GDP (%)

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	90	16.36085	.6517148	6.18271	15.06591	17.65579
1	189	13.70503	.4289974	5.897739	12.85876	14.5513
combined	279	14.56175	.3656741	6.107961	13.8419	15.28159
diff		2.655819	.7672434		1.145451	4.166188

diff = mean(0) - mean(1) t = 3.4615
Ho: diff = 0 degrees of freedom = 277

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9997 Pr(|T| > |t|) = 0.0006 Pr(T > t) = 0.0003

Figure 22: Mean t-test on credits to GDP (%)

Calinsky and Harabasz Index, Duda and Hart Index, and dendrogram from the cluster analysis

Number of clusters	Calinski/ Harabasz pseudo-F
2	77.86
3	108.84
4	254.76
5	278.20
6	328.65
7	421.05
8	478.30
9	520.15
10	589.49
11	768.86
12	864.24
13	974.23
14	1163.41
15	1258.51

Figure 23: Calinksi and Harabasz Index from the cluster analysis

Number of clusters	Duda/Hart Je(2)/Je(1)	Duda/Hart pseudo T-squared
1	0.2280	77.86
2	0.4025	32.65
3	0.2913	51.08
4	0.3886	25.17
5	0.4760	3.30
6	0.0175	56.06
7	0.5035	8.88
8	0.0000	.
9	0.0918	19.79
10	0.4113	7.16
11	0.5180	4.65
12	0.3962	4.57
13	0.0836	21.92
14	0.0000	.
15	0.1237	7.08

Figure 24: Duda and Hart Index from the cluster analysis

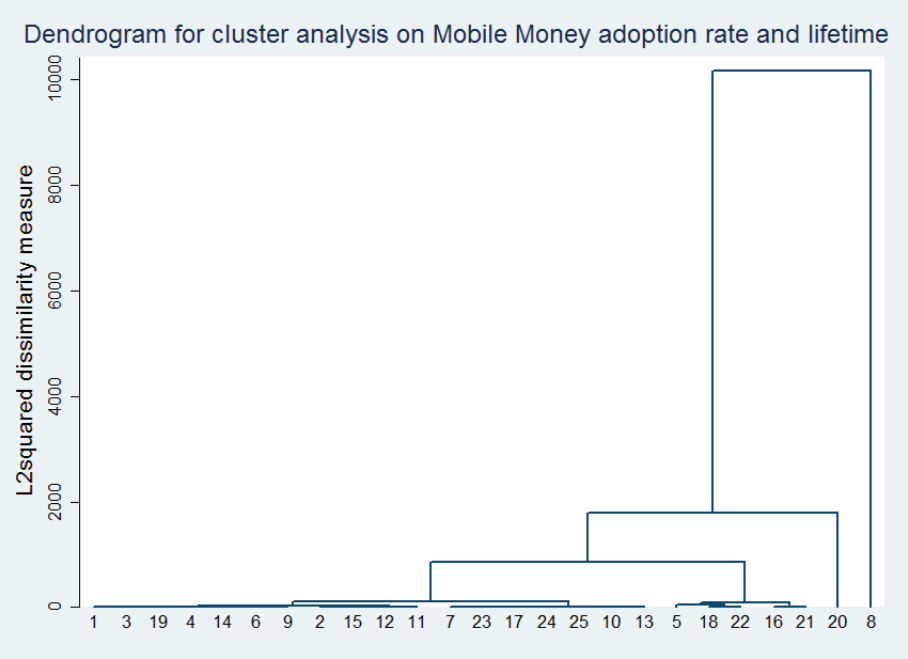

Figure 25: Dendrogram from the cluster analysis

Significant variance t-tests from the cluster analysis

Summary of mobnetwork

clus	Mean	Std. Dev.	Freq.
1	74.090909	29.740392	11
2	75.5	29.029296	6
3	96.2	4.8166378	5
4	85	0	1
5	89	0	1
Total	80.125	25.601142	24

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	1923.41591	4	480.853977	0.69	0.6048
Within groups	13151.2091	19	692.1689		
Total	15074.625	23	655.418478		

Bartlett's test for equal variances: chi2(2) = 9.3702 Prob>chi2 = 0.009

Figure 26: Variance t-test for the variable mobile network

Summary of availability

clus	Mean	Std. Dev.	Freq.
1	.04601767	.06256992	9
2	.0427944	.0515846	5
3	.16131275	.17676688	4
4	.007383	0	1
5	.025502	0	1
Total	.06531335	.09824627	20

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	.047690833	4	.011922708	1.32	0.3083
Within groups	.135703428	15	.009046895		
Total	.183394261	19	.00965233		

Bartlett's test for equal variances: chi2(2) = 7.1163 Prob>chi2 = 0.028

Figure 27: Variance t-test for the variable availability index

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Monnaies mobiles sociales : viabilité et efficacité économiques

RÉSUMÉ :

Les potentialités offertes par l'évolution rapide des technologies actuelles ont favorisé l'émergence de nouveaux moyens de paiement. Ainsi, dans certaines zones, urbaines ou rurales, des monnaies dites sociales circulent par le biais des technologies offertes par la téléphonie mobile. Cette thèse analyse ces monnaies mobiles sociales qui offrent aux consommateurs une complémentarité d'usage par rapport au panel de moyens de paiement existants. Ces nouvelles monnaies répondent à des besoins économiques spécifiques, selon le lieu où elles circulent et les initiatives qui les promeuvent. Elles ont pour objectif le développement économique local, le retour à l'emploi, l'inclusion sociale et l'inclusion financière. Cette thèse étudie les conditions nécessaires à leur déploiement, leur viabilité et leur efficacité. Le premier chapitre est consacré à l'étude théorique des systèmes d'échanges locaux (SEL) au sein desquels circule une monnaie mobile complémentaire. En permettant à leurs membres de conserver un réseau social et de maintenir leurs compétences spécifiques pendant des périodes de chômage, les SEL s'avèrent des instruments performants d'aide au retour à l'emploi. Ce chapitre examine le rôle de la confiance dans l'émergence de tels SEL mais aussi celui du microcrédit en termes d'employabilité et de bien-être. Le deuxième chapitre se concentre sur les monnaies mobiles circulant dans les pays émergents et en développement, à destination de populations faiblement ou non bancarisées. Il propose une analyse empirique des facteurs déterminants dans le déploiement et l'adoption de ces services financiers, afin d'évaluer le potentiel d'inclusion financière de ces monnaies mobiles. Enfin, le troisième chapitre est consacré à l'étude des prérogatives essentielles à l'élaboration des plateformes technologiques permettant le déploiement et la diffusion de monnaies mobiles sociales. Ce chapitre s'appuie sur le cas du projet FIRST dont l'objectif est de déployer une monnaie mobile sociale en Inde. Les résultats de ce chapitre soulignent comment une plateforme de type supply chain peut évoluer en plateforme industrielle d'une part et caractérise d'autre part le rôle des différents acteurs de la plateforme dans cette évolution.

MOTS-CLÉS : Monnaie Mobile Sociale, Monnaie Complémentaire, Développement Economique Local, Retour à l'emploi, Microcrédit, Inclusion Financière, Exclusion Financière, Décision de Localisation des Firmes, Adoption des Technologies de l'Information, Plateforme Technologique, Ecosystème d'Affaires, Connaissances Architecturales

Mobile social money: economic viability and efficiency

ABSTRACT:

Technological progress and innovation on the Information and Communication Technologies have encouraged and made possible the emergence of new means of payment using mobile phone. This Ph.D. thesis analyses the emergence and properties of social mobile money, which is more than a simple means of payment but also a way to provide other services and to satisfy other needs. These new currencies contribute to local development, reemployment, they facilitate social and financial inclusions, according their objectives, their location and the type of organization which develop them. This Ph.D. thesis studies the necessary conditions for implementation, sustainability, and efficiency of mobile social money. The first chapter provides a theoretical setting able to investigate the properties of Local Exchange Trading Systems (LETS) which proposes the use of a social complementary currency. In these conditions, LETS prove to have real advantages for unemployed people: LETS and complementary currencies are able to develop their social network and to maintain their specific skills. These properties help unemployed people to find a new job. This chapter examines the role of confidence in the emergence of such LETS, but also the role of micro-credit inside the LETS, both on employment and on welfare. The second chapter focuses on specific mobile currencies, implemented in emerging and developing countries, and devoted to help financial inclusion of low revenue and unbanked populations. Based on an empirical analysis of determinants of mobile money implementation and adoption, this chapter evaluates the efficiency of complementary currencies in financial inclusion. Finally, the third chapter studies, using the case of FIRST project, necessary conditions for the design of technological platforms providing a social mobile money. This chapter highlights how a supply-chain platform proceeds into an industrial platform and identifies the role of each actor in this evolution.

KEY-WORDS: Mobile Social Money, Complementary Currency, Local Economic Development, Reemployment, Microcredit, Financial Inclusion, Financial Exclusion, Firm Location Decision, Information Technology Adoption, Technological Platform, Business Ecosystem, Architectural Knowledge